TABLE OF CONTENTS

Section		Title	Page No.	
		INTRODUCTION	1	1/A4
A		USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM—VERSION 6	3	1/A6
	A.1	Program Input Parameters	3	1/A6
	A.2	Program Input Data Card Sequence	4	1/A7
	A.3	Preprocessor Program Output	12	1/B1
	A.4	Fortran Source Listing for the NASA/MSFC Cloud-Rise Preprocessor Program —Version 6	12	1/B1
B		USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM — VERSION 6	65	2/B11
	B.1	Program Description	65	2/B11
	B.2	Program Input Parameters	66	2/B12
	B.3	Condensed Table of Namelist Input Parameters	90	2/D8
	B.4	Data Input Format	98	2/E9
	B.5	Fortran Source Listing for the NASA/MSFC Multilayer Diffusion Program — Version 6	99	2/E10

Hem-830-H-14 NASI.26:2945

MAR 7 19[illegible]

ORIGINAL
COMPLETED

NASA Contractor Report 2945

Users' Instructions for the NASA/MSFC Cloud-Rise Preprocessor Program - Version 6, and the NASA/MSFC Multilayer Diffusion Program - Version 6 (Research Version for Univac 1108 System)

J. R. Bjorklund and R. K. Dumbauld

CONTRACT NAS8-31841
JANUARY 1978

NASA

234

NASA CR 2945

NASA Contractor Report 2945

Users' Instructions for the NASA/MSFC Cloud-Rise Preprocessor Program - Version 6, and the NASA/MSFC Multilayer Diffusion Program - Version 6 (Research Version for Univac 1108 System)

J. R. Bjorklund and R. K. Dumbauld
H. E. Cramer Company, Inc.
Salt Lake City, Utah

Prepared for
George C. Marshall Space Flight Center
under Contract NAS8-31841

National Aeronautics
and Space Administration

**Scientific and Technical
Information Office**

1978

INTRODUCTION

This document contains users' instructions for a modified version of the NASA/MSFC Multilayer Diffusion Model Computer Program—Version 5. The instructions assume the reader is familiar with the material contained in NASA Contractor Report NASA CR-2631, "NASA/MSFC Multilayer Diffusion Models and Computer Programs—Version 5, by R. K. Dumbauld and J. R. Bjorklund, December 1975. This modified version of the original program consists of a NASA/MSFC Cloud-Rise Preprocessor Program and a NASA/MSFC Multilayer Diffusion Program, both of which will be referred to as Version 6.

The NASA/MSFC Cloud-Rise Preprocessor Program is executed using any desired vertical profile of meteorological data (usually rawinsonde data) for a specific rocket vehicle and pollutant. The Preprocessor Program automatically calculates the rise of the rocket exhaust cloud, the cloud source dimensions at cloud stabilization, and other necessary inputs required by the NASA/MSFC Multilayer Diffusion Program. On option, the Preprocessor Program either punches the input data to cards or writes the data to mass storage and magnetic tape files for subsequent processing by the Multilayer Diffusion Program. The users' instructions for the NASA/MSFC Cloud-Rise Preprocessor Program—Version 6 are given in Section A.

The NASA/MSFC Multilayer Diffusion Program—Version 6 can be executed from input data prepared by the user or from input data prepared by the Preprocessor Program. If the data are from the Preprocessor Program, they can be in card form or on mass storage and tape, and all data cases can be processed in a single execution with a single blank input card. The Multilayer Diffusion Program uses these input data to calculate, on option, patterns of concentration, dosage, time-mean concentration, time of cloud passage, ground-level deposition and surface water pH due to precipitation scavenging and ground-level deposition due to gravitational settling.

The users' instructions for the Multilayer Diffusion Program—Version 6 are given in Section B.

These versions of the Preprocessor and Multilayer Diffusion Programs differ from previous versions of the programs and now incorporate:

- The latest data for the heat content and chemistry of rocket exhaust clouds
- Provision for the automated calculation of surface water pH due to the deposition of HCl from precipitation scavenging
- Provision for the automated calculation of concentration and dosage parameters at any level within the vertical bounds for which meteorological inputs have been specified
- Provision for execution of multiple cases of meteorological data

In addition, some calculation procedures, such as the procedures used to automatically calculate wind direction shear in a layer, have been updated.

SECTION A

USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR COMPUTER PROGRAM—VERSION 6

This computer program is specifically designed for use with the NASA/MSFC Multilayer Diffusion Program—Version 6 and will not function properly with previous versions of the main program. The Preprocessor Program produces a complete set of data decks for input to the NASA/MSFC Multilayer Diffusion Program—Version 6. The program is specifically designed for use with launches of the Space Shuttle, Titan IIIC, Delta-Thor 2914, Delta-Thor 3914 and Minuteman II vehicles. The data decks produced on option by this program include a complete card deck for each of the four pollutants HCl, CO, CO_2 and Al_2O_3 for Models 3 and/or 4 and/or 5 in the NASA/MSFC Multilayer Diffusion Program—Version 6.

The Cloud-Rise Preprocessor Program is written in Fortran IV and requires approximately 17,000 locations of core storage on the Univac 1108 Computer. The program requires card input, print output and optionally punch or mass storage and tape file output. Sections A.1 and A.2 describe the Program input data. Section A.3 describes the Preprocessor Program output data and Section A.3 gives a complete FORTRAN listing of the Preprocessor Program. For convenience, the NASA/MSFC Multilayer Diffusion Program is referred to as the Main Program in the following text.

A.1 PROGRAM INPUT PARAMETERS

The Preprocessor Program requires the input of the following meteorological parameters:

σ_{AR} - Standard deviation of the wind azimuth angle in degrees measured at the first reference height z_1 over a 10-minute time period

ρ	-	Ambient air density in grams per cubic meter measured at z_1
z	-	Height in feet or meters at which the meteorological measurements are taken
θ	-	Wind direction in degrees at z
u	-	Wind speed in knots or meters per second at z
T	-	Ambient air temperature in degrees Celsius at z
P	-	Ambient air pressure in millibars at z
RH	-	Relative humidity in percent at z

The Program also requires control information indicating: (1) vehicle type, (2) whether the computer run is for a normal or abnormal launch, (3) whether z is in feet or meters, (4) whether u is in knots or meters per second, (5) height of the surface mixing layer which must coincide with one of the z inputs above, and (6) the model being used and the pollutants for which data decks will be produced.

A.2 PROGRAM INPUT DATA CARD SEQUENCE

The first card in the input data deck contains general case titling information and is used for a page heading in the Preprocessor print output and is also punched in the output data deck for input to the Multilayer Diffusion Program. The second input card contains control information and σ_{AR} and ρ at the surface.

Data Card 1:

Columns 1 - 72 (NAMCAS)	-	General data set titling information. If input as blanks, the program will use the information input into the previous case processed.

Data Card 2:

Column 1 (NSPECL)	-	Number of special data cards containing additional inputs to pass on to the Main Program This data is described under Data Card N + 2 to M (EXTR) below. The maximum value is 5.
Columns 2 - 4 (VEHICL)	-	Punch these characters indicating the vehicle type. If left blank Titan IIIC is assumed. TTN is the Titan IIIC vehicle; STL is the Space Shuttle vehicle; DT2 is the Delta-Thor 2914 vehicle; DT3 is the Delta-Thor 3914 vehicle; MIN is the Minuteman II vehicle.
Columns 5 - 7 (NØRMAL)	-	Punch YES or leave blank if the run is for a normal launch. Punch NØ1 if the run is for an abnormal launch where a single engine burns on the launch pad. Not produced for the Delta-Thor and Minuteman II vehicles. Punch NØ2 if the run is for an abnormal launch where a slow burn on the pad occurs. (Ø is alphabetic)
Column 8 (IFEET)	-	Punch M or leave blank if the heights z are in meters. Punch F if the heights are in feet.
Column 9 (KNOTS)	-	Punch M or leave blank if the wind speed u is in meters per second.
Columns 10-39 (DATE)		Punch the date of the meteorological case or any case identification information (optional).
Columns 40-45* (TPRØP)	-	Punch the initial temperature of the solid propellant in degrees F. If left blank, the average temperature at KSC for the indicated month is used.
Columns 46-51* (SIGAR)	-	Punch σ_{AR}

Data Card 2 (Continued)

Columns 52-58* (RHO) - Punch ρ

Columns 59-66* (ZSP) - Punch any special calculation height in the same units as z below. These columns are optional and if punch, this height and the surface height (o) are passed to the Main Program for calculations.

Column 67 (ISW(1)) - Punch a 1 if output (dosage and concentration) for Model 4 is desired; leave blank if not.
Punch a 2 if output for Model 5 is desired (precipitation deposition) using the Model 4 source and meteorological structure (HCl only). Punch a 3 if output (dosage and concentration) for Model 4 including depletion due to precipitation scavenging is desired.

Column 68 (ISW(2)) - Punch a 1 if output (dosage and concentration) for Model 3 is desired; leave blank if not.
Punch a 2 if output for Model 5 is desired using the Model 3 source and meteorological structure (HCl only). Punch a 3 if output (dosage and concentration) for Model 3 including depletion due to precipitation scavenging is desired.

Column 69 (ISW(3)) - Punch a 1 if output for HCl is desired; leave blank if not.

Column 70 (ISW(4)) - Punch a 1 if output for CO is desired; leave blank if not. (Not produced for Model 5).

Column 71 (ISW(5)) - Punch a 1 if output for Al_2O_3 is desired; leave blank if not. (Not produced for Model 5).

Column 72 (ISW(6)) - Punch a 1 if output for CO_2 is desired; leave blank if not. Produced only for the Titan IIIC vehicle. (Not produced for Model 5).

Column 73 (ISW(7)) - Punch a 1 if cloud the trajectory range and azimuth bearing are to be calculated and cloud rise time is to be printed; leave blank if not.

Data Card 2 (continued)

Column 74 (ISW(8)) - Punch a 1 if the distribution of the source material in the layers is to have an elliptical shape. Leave blank if the distribution is to be spherical.

Column 75 (ISW(9)) - Punch a 1 if column 67 or 68 is a 2 for Model 5 and output units in pH (surface water acidity) from the Main Program are desired. Leave blank if Model 5 is to be in milligrams per square meter. (Option ISKIP(9) in Main Program).

Column 76 (ISW(10)) - If left blank, the program provides for calculations in the Main Program at the surface and at the special height specified in Columns 59-66 (if punched). Punch a 1 if Main Program calculations are to be performed at only the cloud rise height (H) and at the special height specified in Columns 59-66 (if punched). Punch a 2 if main model calculations are to be performed at the surface, the cloud rise height (H) and the special height specified in Columns 59-66 (if punched).

Column 77 (ISW(11)) - Punch a 1 if column 67 or 68 is a 2 and maximum possible precipitation deposition from Model 5 is desired. Leave blank if Model 5 is not being used or if the precipitation deposition from Model 5 is to be dependent upon the time of the start of precipitation. (Option ISKIP(4) in Main Program).

Column 78 (ISW(12)) - Punch a 1 if concentration and dosage of precipitation deposition from the Main Program is to be printed for all calculation points. Leave blank if not. (Option ISKIP(1) in Main Program)

Column 79 - Punch a 1 if maximum centerline concentration and maximum dosage or maximum centerline precipitation deposition are to be printed by the Main Program. Punch a 2 for maximum centerline plots only. Punch a 3 for maximum centerline print and plot. (Option ISKIP(2) in Main Program).

Data Card 2 (continued)

Column 80 (ISW(14)) - Punch a 1 if isopleths of concentration and dosage or precipitation deposition are to be printed by the Main Program. Punch a 2 if isopleth plots are only produced. Punch a 3 if isopleths are to be printed and plotted. (Option ISKIP(3) in Main Program).

Data Card 3: (This data card is read only if column 74 of data card 2 is 1).

Column 1-4* (GAMMAX) - Punch the entrainment parameter for the alongwind dimension of the elliptically shaped cloud. If left blank, the program uses .64 for a normal launch or .5 for an abnormal launch.

Column 5-8* (GAMMAY) - Punch the entrainment parameter for the crosswind dimension of the elliptically shaped cloud. If left blank the program uses .64 for a normal launch or .5 for an abnormal launch.

Column 9-12* (GAMMAZ) - Punch the entrainment parameter for the vertical dimension of the elliptically shaped cloud. If left blank the program uses .64 for a normal launch or .5 for an abnormal launch.

Data Card 4:

Column 1-2 (METUNT) - Punch the Fortran logical unit number right justified from which the input data is to be read. If left blank, the program uses logical unit 5.

Column 5-6 (METDAT(1)) - Punch the month of the meteorological data right justified.

Column 7-8 (METDAT(2)) - Punch the day of the meteorological data right justified.

Column 9-10 (METDAT(3)) - Punch the year of the meteorological data right justified.

Data Card 4 (continued)

Column 13-14 (NSND) - Punch the hour of the meteorological sounding right justified (00-24).

Column 17-18 (IØUNT) - Punch the Fortran logical unit number for the output data right justified. If 7 is punched, the output data is punched to cards. If left blank or 10 is punched, the output data is written to mass storage random access unit 10 as a case inventory. Also, a directory of cases on unit 10 is written sequentially to tape or mass storage unit 12. It is the user's responsibility to assign units 10 and 12. Unit 10 must be a mass storage file of at least 14 positions on the Univac 1108 and unit 12 can be either mass storage or tape. These files can be temporary or permanent files and, if temporary, the Preprocessor and Main Program should be executed sequentially in the same run.

Data Card 5: (This data card is read only if card column 67 or 68 on data card 2 is greater than 1).

Column 1-10* (RAINRT) - Punch the rainfall rate in inches per hour. If left blank, the program uses 0.3 inches per hour.

Column 11-20* (LAMBDA) - Punch the rainfall scavenging coefficient in units of per second. If left blank, the program will calculate the scavenging coefficient using the following equation

$$\text{scavenging coefficient} = 5.2 \times 10^{-4}(R)^{0.567}$$

where R is the rainfall rate in inches per hour

Column 21-30* (TIM1) - Punch the time of the start of rain (seconds) after launch time. If left blank, zero is used. This parameter is not used if maximum possible precipitation deposition is being calculated.

Column 31-40* (ZLIM) - Punch the maximum height in meters through which precipitation can occur. If left blank, the program uses the height selected for the mixing layer height.

Data Card 5 (continued)

Column 41-50* (DURAT) - Punch the duration of the rain in hours. If left blank, the program uses 1 hour. This parameter is not used if maximum possible precipitation is being calculated.

Data Card 6-N: (N must be less than or equal to 26).

Column 1-10* (Z) - Punch the height of the layer boundary or sounding height.

Column 11-20* (WD) - Punch the wind direction in degrees.

Column 21-30* (WS) - Punch the wind speed.

Column 31-40* (T) - Punch the temperature in degrees Celsius.

Column 41-50* (P) - Punch the pressure in millibars.

Column 51-60* (RH) - Punch the relative humidity in percent.

Column 80 (IHM) - Punch an asterisk (*) if the height on this card is the surface mixing layer height. If none of the data cards contains an asterisk, then the last height input is used as the surface mixing layer height.

Data Card N + 1:

Column 1-60: - This card signifies the end of the layer meteorological data on data cards 6-N by leaving columns 1-60 blank.

Data Card N + 1 (continued)

Column 80: - Punch a 1 if this case is to be followed by another data case. Leave blank if this is the last data case for the Preprocessor to process.

Data Card N + 2 - M: (These data cards are not read if column 1 on data card 2 is blank or zero. Otherwise, M is the value in column 1 on data card 2 plus N + 1).

Column 1-80 (EXTR) - Punch data input variables in a namelist format for use in the Main Program that are not used or provided for in the Preprocessor. Any variable that can be input to the Main Program can be included in these data cards. The number of data cards is given in column 1 on data card 2. The program reads these cards and inserts them unaltered at the end of the preprocessor namelist output prior to the $END card. Any variable entered on these cards will override any equivalent variable produced by the preprocessor. The data items input are punched exactly as if they were to be included in an input namelist deck to the Main Program, except $NAM2 and $END cannot appear on these cards. For example, if the user wants to use a special grid system rather than the Main Program default grid system, the following data could be input beginning in column 2. NXS = 10, XX = 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 10000, This input data would change the axis radial distances used in the Main Program calculations for this and subsequent case runs. If this input data is not to be used or if the default axis is to be used in subsequent cases these values must be changed in these cases to the desired values. Setting NXS = O in the next case would result in the default radial axis.

*Each of these fields is read using a format for real numbers. Except for data card 3, the number punched in these fields must include a decimal point (period) unless it is a right justified whole number in the field. If the decimal point is omitted on data card 3, the two low order digits in each field are assumed to be the tenths and hundreths positions of the number.

A.3 PREPROCESSOR PROGRAM OUTPUT

The Preprocessor Program will produce a complete card deck for direct input to the NASA/MSFC Multilayer Diffusion Program—Version 6. The first card of each of the output data decks is a case identification card containing the vehicle type, date of sounding, and pollutant type. The second card contains $NAME and the last card of each case deck contains $END. A complete description of this entire deck is given in Section B. The possible data decks output are:

Inputs for:

(1)	HCl	-	Model 4
(2)	CO	-	Model 4
(3)	CO_2	-	Model 4
(4)	Al_2O_3	-	Model 4
(5)	HCl	-	Model 3
(6)	CO	-	Model 3
(7)	CO_2	-	Model 3
(8)	Al_2O_3	-	Model 3
(9)	HCl	-	Model 5 and 4
(10)	MCl	-	Model 5 and 3

A.4 FORTRAN SOURCE LISTING FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM VERSION 6

This section contains the complete FORTRAN source listing of the NASA/MSFC Cloud-Rise Preprocessor Program— Version 6.

```
1*          **   NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM - VERSION 6        **
2*          **                                                                 **
3*
4*              PROGRAM VHICLE, VERSION 6, REVISION 0
5*
6*      C    * PLUME RISE AND SOURCE DISTRIBUTION PREPROCESSOR PROGRAM FOR USE   VHC00100
7*      C    * WITH THE NASA/MSFC MULTILAYER DIFFUSION MODEL - VERSION 5A.       VHC00200
8*      C    *                                                                   VHC00300
9*      C                                                                        VHC00400
10*     C      *-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-VHC00500
11*     C                                                                        VHC00600
12*             COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),VHC00700
13*            1P(21),Z(21),UBAR(21),NZS,Q(20),QT,HM,SIGEP(21),SIGAP(21),G,TAUK,  VHC00800
14*            2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                    VHC00900
15*             COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS           VHC01000
16*             COMMON /SIG/ SIGXO(20),SIGYO(20),SIGZO(20),H                      VHC01100
17*             COMMON /F/ DATE(6),FRQ(4),WTMOL(3)                               VHC01200
18*             DIMENSION IPOL(4),I1(160),I2(12),I3(61),I4(13),I5(142),ITP(2),JP(2VHC01300
19*            1),ISW(14)                                                        VHC01400
20*             DIMENSION WS(21),I6(44),CC(8)                                    VHC01500
21*             INTEGER YES,VEHICL,TYPE,TYPES,UNITS                              VHC01600
22*             DIMENSION TYPE(8),QC1(8),QT1(8),QC2(8),QT2(8),QC3(8),QT3(8),AA(8),VHC01700
23*            1BB(8),HEATN(8),HEATA(8),FRQ1(4,8),FRQ2(4),TYPES(15),UNITS(4),     VHC01800
24*            2LNCH(11),LNTL(8),HEATM(8)                                        VHC01900
25*             DIMENSION DDI(10,4),CCI(10,4),TTI(10,4)                          VHC02000
26*             DIMENSION DDIP(10)                                               VHC02100
27*             DATA DDIP/12.,10.,8.,6.,4.,2.,4*0./                              VHC02200
28*             DATA TYPE/3HTTN,3HSTL,3HDT2,3HMIN,3HDT3,3*3H   /                 VHC02300
29*             DATA QC1/5.437528E6,1.52671702E7,8.360685E5,4.684476E5,1.057557E6,VHC02400
30*            13*0.0/                                                           VHC02500
31*             DATA QT1/3.2625168E6,1.894794173E9,2.887598E7,2.8106856E7,6.702691VHC02600
32*            1E7,3*0.0/                                                        VHC02700
33*             DATA QC2/2.7187b4E6,6.882968E6,9.09811E4,4.684476E5,1.482923E5,3*0VHC02800
34*            1.0/                                                              VHC02900
35*             DATA QT2/1.6312584E8,8.56929516E8,3.14229E6,2.8106856E7,9.398616E6VHC03000
36*            1,3*0.0/                                                          VHC03100
37*             DATA QC3/1.359382E6,3.441484E6,2.729434E5,1.171119E5,3.70731E5,3*0VHC03200
38*            1.0/                                                              VHC03300
```

```
      DATA QT3/3.2625166E8,1.713859032E9,1.685373E7,2.8106856E7,4.699308VHC03400
     1E7,3*0.0/                                                        VHC03500
      DATA AA/.429560469,.6522129891,.922156,.469982,1.245756,3*0.0/   VHC03600
      DATA BB/.5164223,.4680846,.432703,.463333,.4180947,3*0.0/        VHC03700
      DATA CC/5.0,.375,.54,5*0.0/                                      VHC03800
      DATA HEATN/2021.1,1479.7,1766.0,2055.9,1449.9,3*0.0/             VHC03900
      DATA HEATM/1010.55,1062.35,1000.0,2055.9,1000.0,3*0.0/           VHC04000
      DATA HEATA/2*1000.0,690.0,1000.0,411.18,3*0.0/                   VHC04100
C     FRACTIONAL DIST FOR MINUTEMAN II ABNORMAL LAUNCH                 VHC04200
      DATA FRQ2/.2042109,.2188377,.0,.2799704/                         VHC04300
      DATA FRQ1/.1932,.2665,.0222,.2819,.1702,.2021,.0286,.2524,.1218, VHC04400
     1.2055,.0156,.2214,.1977,.2380,.0318,.2761,.1589,.2783,.0331,.1936,VHC04500
     212*0.0/                                                          VHC04600
      DATA TYPES/90HTITAN IIIC         SPACE SHUTTLE     DELTA-THOR 2914 VHC04700
     1  MINUTEMAN II       DELTA-THOR 3914    /                        VHC04800
      DATA UNITS/24H PPM          ML/M**3     /                        VHC04900
      DATA LNCH/66H     NORMAL LAUNCHSINGLE ENGINE BURN          SLOW BURVHC05000
     1NVEHICLE     /                                                   VHC05100
      DATA NAMT/12*1H /                                                VHC05200
      DATA CCI/16.0,8.0,4.0,1.0,0.5,0.1,4*0.0,35.0,10.0,4.0,2.0,1.0,0.1,VHC05300
     14*0.0,20.0,10.0,5.0,3.0,1.0,0.5,4*0.0,2.0,1.0,0.4,0.1,0.05,0.01,4*VHC05400
     220.0/                                                            VHC05500
      DATA DDI/400.0,200.0,100.0,50.0,25.0,5.0,4*0.0,400.0,200.0,100.0, VHC05600
     1150.0,25.0,5.0,4*0.0,400.0,200.0,100.0,50.0,25.0,5.0,4*0.0,40.0,  VHC05700
     1220.0,10.0,5.0,2.5,0.5,4*0.0/                                    VHC05800
      DATA TTI/30.0,4.0,8.0,2.0,1.0,0.5,4*0.0,150.0,100.0,60.0,30.0,15.0VHC05900
     1,1.0,4*0.0,5.0,2.0,1.0,.5,.1,.05,4*0.0,50.0,100.0,25.0,10.0,5.0,1.VHC06000
     220,4*0.0/                                                        VHC06100
      DATA JP/12H FEET METERS/,NO/3H NO/,NO1/3HNO1/,NO2/3HNO2/         VHC06200
      DATA YES/3HYES/,IPOL/24H HCL    CO     CO2    AL203/,ITP/1HF,1HK/ VHC06300
      DATA IAST/1H*/                                                   VHC06400
      DATA IBLK/3H   /,IBNK/1H /,NMS/1HM/                              VHC06500
      COMMON /OUT/ WF(20,4),WD(21),ISKIP(10),NDI,NCI,NTI,ZRK,JBOT,JTOP, VHC06600
     1IZMOD(21),CI(10),DI(10),TI(10),NPS                               VHC06700
      COMMON /PRECIP/ RAINRT,LAMBDA,TIM1,ZLIM,DURAT,JSWS,EXTR(70),NSPECLVHC06800
      COMMON/DISPL/ DXX,DX(21),DYY,DY(21),ILXY,TIMC(21)                VHC06900
      COMMON /CASCRD/ NVHCL,METDAT(3),NMODL,NPLNT,NSND,IOUNT,IASV      VHC07000
      DIMENSION METDTC(3),AVTEMP(12)                                   VHC07100
```

```
      REAL LAMBDA                                                       VHC07200
      INTEGER EXTR                                                      VHC07300
      DATA IZERO,ISTRTC,IENDC,ISTART/4*0/                               VHC07400
      DATA AVTEMP/69.9,67.26,69.57,74.19,78.33,81.81,83.06,83.55,82.45, VHC07500
     1179.32,73.15,65.62/                                               VHC07600
      EQUIVALENCE (IBLK,BLKS)                                           VHC07700
      EQUIVALENCE (WS,UBAR),(I1,CC),(I2,ZM),(I3,SIGXC),                 VHC07800
     1(I4,DATE),(I5,GF),(I6,DXX)                                        VHC07900
C                                                                       VHC08000
C                    *** PROGRAM INPUTS ***                             VHC08100
C-DATA CARD 1                                                           VHC08200
C     NAMCAS - GENERAL DATA SET TITLING INFORMATION (CARD 1 COL 1-72)   VHC08300
C              IF INPUT AS BLANKS THE INFORMATION IN THE LAST CASE INPUVHC08400
C              IS USED                                                  VHC08500
C-DATA CARD 2                                                           VHC08600
C     NSPECL - NUMBER OF SPECIAL DATA CARDS CONTAINING ADDITIONAL       VHC08700
C              INPUTS THAT FOLLOW THE LAYER DATA VARIABLES UNDER EXTR   VHC08800
C              BELOW - (MAXIMUM OF 5, DEFAULT=0) (CARD 2 COL 1)         VHC08900
C     VEHICL - THREE CHARACTERS GIVING THE VEHICLE TYPE (CARD 2 COL 2-4)VHC09000
C              TTI IS TITAN IIIC VEHICLE (DEFAULT)                      VHC09100
C              STL IS SPACE SHUTTLE VEHICLE                             VHC09200
C              DT2 IS DELTA-THOR 2914 VEHICLE                           VHC09300
C              MIN IS MINUTEMAN II VEHICLE                              VHC09400
C              DT3 IS DELTA-THOR 3914 VEHICLE                           VHC09500
C     NORMAL - THREE CHARACTERS GIVING THE TYPE OF LAUNCH(CRD 2 COL 5-7)VHC09600
C              YES IS A NORMAL LAUNCH (DEFAULT)                         VHC09700
C              NO1 IS A SINGLE ENGINE BURN ABNORMAL LAUNCH              VHC09800
C              NO2 IS A SLOW BURN ABNORMAL LAUNCH                       VHC09900
C     IFEET - 1 CHARACTER IF Z IS IN FEET PUNCH F, IF Z IS IN METERS    VHC10000
C              PUNCH M, (CARD 2 COL 8) (DEFAULT=M)                      VHC10100
C     KNOTS - 1 CHARACTER IF WS IS IN METERS/SEC PUNCH M, IF WS IS IN   VHC10200
C              KNOTS PUNCH K, (CARD 2 COL 9) (DEFAULT=M)                VHC10300
C     DATE - 30 CHARACTERS IDENTIFYING THE METEOROLOGICAL DATA CASE     VHC10400
C            WITHIN THE GENERAL DATA CASE IDENTIFIED IN NAMCAS ABOVE    VHC10500
C            (CARD 2 COL 10-39)                                         VHC10600
C     TPROP - INITIAL TEMPERATURE OF SOLID PROPELLANT (DEG F)           VHC10700
C              (DEFAULT IS AVERAGE TEMP. AT KSC FOR THAT MONTH IF BLANK) VHC10800
C              (CARD 2 COL 40-45, F6.0 FORMAT)                          VHC10900
```

```
115*      C     SIGAR - STANDARD DEVIATION OF THE WIND AZIMUTH ANGLE AT THE       VHC11000
116*      C             SURFACE MEASUREMENT HEIGHT (DEGREES) (CARD 2 COL 46-51)   VHC11100
117*      C             (F6.0 FORMAT)                                             VHC11200
118*      C     RHO - SURFACE AIR DENSITY (G/M**3) (CARD 2 COL 52-58 F7.0 FORMAT) VHC11300
119*      C     ZSP - SPECIAL CALCULATION HEIGHT IN ADDITION TO THE SURFACE       VHC11400
120*      C           HEIGHT IN THE SAME UNITS AS Z BELOW (CARD 2 COL 59-66)      VHC11500
121*      C           (F8.0 FORMAT)                                               VHC11600
122*      C     ISW(1) - IF SET TO 1 CALCULATE PARAMETERS FOR MODEL 4             VHC11700
123*      C              IF SET TO 2 CALCULATE PARAMETERS FOR MODEL 4 AND USE     VHC11800
124*      C              IN CONJUNCTION WITH MODEL 5 - (DATA CARD 5 IS READ WITH  VHC11900
125*      C              THIS OPTION)                                             VHC12000
126*      C              MODEL 5 IS THE PRECIPITATION DEPOSITION MODEL (SEE ISW(9)VHC12100
127*      C              AND ISW(11) AND DATA CARD 5                              VHC12200
128*      C              IF SET TO 3 CALCULATE PARAMETERS FOR MODEL 4 AS IF 1 BUT VHC12300
129*      C              ALSO INPUT CARD UNIT 5 TO CALCULATE CONCENTRATION AND    VHC12400
130*      C              DOSAGE WITH DEPLETION DUE TO PRECIPITATION SCAVENGING    VHC12500
131*      C              IF SET TO 0 MODEL 4 IS NOT PRODUCED (CARD 2 COL 67)      VHC12600
132*      C     ISW(2) - IF SET TO 1 CALCULATE PARAMETERS FOR MODEL 3             VHC12700
133*      C              IF SET TO 2 CALCULATE PARAMETERS FOR MODEL 3 AND USE     VHC12800
134*      C              IN CONJUNCTION WITH MODEL 5 - (DATA CARD 5 IS READ WITH  VHC12900
135*      C              THIS OPTION)                                             VHC13000
136*      C              IF SET TO 3 CALCULATE PARAMETERS FOR MODEL 3 AS IF 1, BUTVHC13100
137*      C              ALSO INPUT CARD UNIT 5 TO CALCULATE CONCENTRATION AND    VHC13200
138*      C              DOSAGE WITH DEPLETION DUE TO PRECIPITATION SCAVENGING    VHC13300
139*      C              IF SET TO 0 MODEL 3 IS NOT PRODUCED (CARD 2 COL 68)      VHC13400
140*      C     ISW(3) - IF SET TO 1 DATA FOR HCL IS PRODUCED                     VHC13500
141*      C              IF SET TO 0 HCL ISNOT PRODUCED (CARD 2 COL 69)           VHC13600
142*      C      ISW(4) - IF SET TO 1 DATA FOR CO IS PRODUCED                     VHC13700
143*      C              IF SET TO 0 CO IS NOT PRODUCED (CARD 2 COL 70)           VHC13800
144*      C     ISW(5) - IF SET TO 1 DATA FOR AL2O3 IS PRODUCED                   VHC13900
145*      C              IF SET TO 0 AL2O3 IS NOT PRODUCED (CARD 2 COL 71)        VHC14000
146*      C     ISW(6) - IF SET TO 1 DATA FOR CO2 IS PRODUCED                     VHC14100
147*      C              IF SET TO 0 CO2 IS NOT PRODUCED (CARD 2 COL 72)          VHC14200
148*      C     ISW(7) - IF SET TO 1 THE CLOUD TRAJECTORY COORDINATES DELX,DELY   VHC14300
149*      C              ARE CALCULATED AND PUNCHED FOR EACH LAYER.  IF SET TO 0  VHC14400
150*      C              CLOUD TRAJECTORY COORDINATES ARE NOT CALCULATED          VHC14500
151*      C              ALSO, LAYER CLOUD RISE TIME IS CALCULATED (CARD 2 COL 73)VHC14600
152*      C     ISW(8) - IF SET TO 1 THE PROGRAM USES AN ELLIPTICAL SHAPE RATHER  VHC14700
```

```
153*      C                THAN A SPHERICAL SHAPE TO DETERMINE THE DISTRIBUTION OF  VHC14800
154*      C                MATERIAL IN THE LAYERS. (CARD 2 COL 74)                  VHC14900
155*      C      ISW(9) - THIS PARAMETER IS USED ONLY IF ISW(1) OR ISW(2) EQUALS 2.VHC15000
156*      C                IF ISW(9) = 0 THE OUTPUT UNITS OF PRECIPITATION          VHC15100
157*      C                DEPOSITION WILL BE MG/M**2. IF ISW(9) = 1 THE UNITS WILL VHC15200
158*      C                BE PH FOR HCL ONLY. (CARD 2 COL 75)                      VHC15300
159*      C      ISW(10)- IF SET TO 0 THE PROGRAM PROVIDES FOR SURFACE CALCULATIONSVHC15400
160*      C                ONLY OR IF ZSP IS INPUT AT THE SURFACE AND ZSP.          VHC15500
161*      C                IF SET TO 1 THE PROGRAM PROVIDES FOR CALCULATIONS AT THE VHC15600
162*      C                CLOUD RISE HEIGHT H AND AT ZSP IF INPUT                  VHC15700
163*      C                IF SET TO 2 THE PROGRAM PROVIDES FOR CALCULATIONS AT THE VHC15800
164*      C                SURFACE, THE CLOUD RISE HEIGHT H AND AT ZSP IF INPUT     VHC15900
165*      C                (CARD 2 COL 76)                                          VHC16000
166*      C      ISW(11)- THIS PARAMETER IS USED ONLY IF ISW(1) OR ISW(2) EQUALS 2.VHC16100
167*      C                IF ISW(11) IS SET = 1, THE MAXIMUM POSSIBLE GROUND-LEVEL VHC16200
168*      C                PRECIPITATION DEPOSITION IS CALCULATED. THE CALCULATIONS VHC16300
169*      C                ARE INDEPENDENT OF THE TIME PRECIPITATION BEGINS.        VHC16400
170*      C                IF ISW(11) IS SET = 0, THE PRECIPITATION DEPOSITION IS   VHC16500
171*      C                DEPENDENT UPON THE TIME OF START OF PRECIPITATION.       VHC16600
172*      C                (CARD 2 COL 77)                                          VHC16700
173*      C      ISW(12) - IF > 0 PRINT ALL GRID CALCULATIONS OF CONCENTRATION,     VHC16800
174*      C                 DOSAGE, DEPOSITION, ETC. FROM MAIN MODEL. (DEFAULT=0)   VHC16900
175*      C                 ( CARD 2 COL 78)                                        VHC17000
176*      C      ISW(13) - IF > 0 CALC. MAXIMUM CENTERLINE VALUES OF CONCENTRATIONVHC17100
177*      C                 DOSAGE, DEPOSITION, ETC. FROM MAIN MODEL.               VHC17200
178*      C                 IF = 1 VALUES ARE PRINTED ONLY                          VHC17300
179*      C                 IF = 2 VALUES ARE PLOTTED ONLY                          VHC17400
180*      C                 IF = 3 VALUES ARE BOTH PRINTED AND PLOTTED              VHC17500
181*      C                 (CARD 2 COL 79)                                         VHC17600
182*      C      ISW(14) - IF > 0 CALC. ISOPLETHS OF CONCENTRATION, DOSAGE,         VHC17700
183*      C                DEPOSITION, ETC. FROM MAIN MODEL.,                       VHC17800
184*      C                IF = 1 VALUES ARE PRINTED ONLY.                          VHC17900
185*      C                IF = 2 VALUES ARE PLOTTED ONLY                           VHC18000
186*      C                IF = 3 VALUES ARE BOTH PRINTED AND PLOTTED               VHC18100
187*      C                (CARD 2 COL 80)                                          VHC18200
188*      C                                                                         VHC18300
189*      C-DATA CARD 3 (READ ONLY IF ISW(8) IS NON-ZERO)                           VHC18400
190*      C      THE FOLLOWING PARAMETERS ON CARD 3, GAMMAX,GAMMAY,GAMMAZ ALL USE  VHC18500
```

```
*91*      C      AN F4.2 FORMAT. ALSO, THIS CARD IS NOT READ IF ISW(6)=0. ALSO,     VHC18600
*92*      C      THE DEFAULT VALUE FOR EACH PARAMETER IS .64 FOR A NORMAL LAUNCH    VHC18700
*93*      C      AND .5 FOR AN ABNORMAL LAUNCH. ALSO, THE PRODUCT OF ALL THREE      VHC18800
*94*      C      PARAMETERS MUST EQUAL (.64)**3 FOR A NORMAL LAUNCH OR IF ABNORMAL  VHC18900
*95*      C      GAMMAX*GAMMAY MUST EQUAL (0.5)**2                                  VHC19000
*96*      C      GAMMAX - ENTRAINMENT PARAMETER FOR THE X OR ALONG-WIND DIMENSION    VHC19100
*97*      C               FOR AN ELLIPTICALLY SHAPED CLOUD (ISW(6)=1 ONLY)          VHC19200
*98*      C               (CARD 5 COL 1-4) (USE DEFAULT FOR DELTA-THOR)             VHC19300
*99*      C      GAMMAY - ENTRAINMENT PARAMETER FOR THE Y OR CROSSWIND DIMENSION    VHC19400
*00*      C               FOR AN ELLIPTICALLY SHAPED CLOUD (ISW(6)=1 ONLY)          VHC19500
*01*      C               (CARD 5 COL 5-8) (USE DEFAULT FOR DELTA-THOR)             VHC19600
*02*      C      GAMMAZ - ENTRAINMENT PARAMETER FOR THE Z OR VERTICAL DIMENSION     VHC19700
*03*      C               FOR AN ELLIPTICALLY SHAPED CLOUD (ISW(6)=1 ONLY)          VHC19800
*04*      C               (CARD 5 COL 9-12) (USE DEFAULT FOR DELTA-THOR)            VHC19900
*05*      C-DATA CARD 4                                                             VHC20000
*06*      C      METUNT - FORTRAN UNIT FROM WHICH TO READ MET. DATA (CARD 4 COL1-2) VHC20100
*07*      C               DEFAULT = 5 CARD DATA.                                    VHC20200
*08*      C      METDAT(1) - MONTH OF MET. DATA (CARD 4 COL 5-6)                    VHC20300
*09*      C      METDAT(2) - DAY OF MET. DATA (CARD 4 COL 7-8)                      VHC20400
*10*      C      METDAT(3) - YEAR OF MET. DATA (CARD 4 COL 9-10)                    VHC20500
*11*      C      NSND - HOUR OF SOUNDING (0-24) (CARD 4 COL 13-14)                  VHC20600
*12*      C      IOUNT - FORTRAN UNIT WHERE PUNCH OUT IS TO BE SENT (CARDS OR TAPE) VHC20700
*13*      C              (CARD 4 COL 17-18) (DEFAULT = 10 MASS STORAGE UNIT 10)     VHC20800
*14*      C              IF IOUNT = 10 THE PROGRAM REQUIRES MASS STORAGE LOGICAL    VHC20900
*15*      C              UNIT 10 AND TAPE OR MASS STORAGE LOGICAL UNIT 12. UNIT     VHC21000
*16*      C              12 CONTAINS THE DIRECTORY INFORMATION FOR EACH CASE AND    VHC21100
*17*      C              UNIT 10 CONTAINS THE CASE DATA CARD INFORMATION IN A CARD  VHC21200
*18*      C              IMAGE FORMAT FOR NAMELIST INPUT.                           VHC21300
*19*      C-DATA CARD 5 (READ ONLY IF ISW(1) OR ISW(2) EQUALS 2 OR 3)               VHC21400
*20*      C      RAINRT - RAINFALL RATE FOR PRECIPITATION DEPOSITION (MODEL 5)      VHC21500
*21*      C               (CARD 5 COL 1-10) IN UNITS OF INCHES PER HOUR.            VHC21600
*22*      C               (F10.0 FORMAT). (DEFAULT = 0.3 INCHES/HOUR)               VHC21700
*23*      C      LAMBDA - RAINFALL SCAVENGING COEFFICIENT (CARD 5 COL 11-20) IF     VHC21800
*24*      C               ZERO OR BLANK LAMBDA IS CALCULATED FROM RAINRT.           VHC21900
*25*      C               (F10.0 FORMAT)                                            VHC22000
*26*      C      TIM1 - TIME IN SECONDS OF START OF RAIN (CARD 5 COL 21-30). TIM1   VHC22100
*27*      C             IS MEASURED FROM LAUNCH TIME AND IS USED ONLY IF ISW(11)    VHC22200
*28*      C             ABOVE IS SET TO 0. (F10.0 FORMAT) (DEFAULT = 0.0)          VHC22300
```

```
C      ZLIM - MAXIMUM HEIGHT THROUGH WHICH PRECIPITATION CAN OCCUR.      VHC22400
C           (CARD 5 COL. 31-40 F10.0 FORMAT). (DEFAULT = THE HEIGHT      VHC22500
C           SELECTED FOR THE SURFACE MIXING LAYER HEIGHT HM)             VHC22600
C           (UNITS ARE THE SAME AS Z BELOW)                              VHC22700
C      DURAT - DURATION OF RAIN IN HOURS, USED ONLY IF ISW(11) = 0.      VHC22800
C            (DEFAULT = 1 HR) (CARD 5 COL 41-50 F10.0 FORMAT)           VHC22900
C-DATA CARDS 6-N                                                        VHC23000
C      THE FOLLOWING PARAMETERS EXCEPT IHM ALL USE AN F10.0 FORMAT      VHC23100
C      Z - HEIGHT OF LAYER BOUNDARIES (FEET OR METERS) COL 1-10         VHC23200
C      WD - WIND DIRECTION AT EACH Z (DEGREES) COL 11-20                VHC23300
C      WS - WIND SPEED AT EACH Z (KNOTS OR METERS/SEC) COL 21-30        VHC23400
C      T  - TEMPERATURE AT EACH Z (DEGREES C) COL 31-40                 VHC23500
C      P  - PRESSURE AT EACH Z (MILLIBARS) COL 41-50                    VHC23600
C      RH - RELATIVE HUMIDITY AT EACH Z (PERCENT) COL 51-60             VHC23700
C      IHM - ASTERISK (*) IN COLUMN 80 IF THE HEIGHT Z ON THIS CARD IS  VHC23800
C      THE SURFACE MIXING LAYER HEIGHT HM.  IF NOT FOUND THE LAST Z INPUTVHC23900
C      IS USED FOR HM.                                                  VHC24000
C      THE DATA CARD THAT SIGNIFIES THE END OF THE LAYER MET DATA IS ALL VHC24100
C      BLANK EXCEPT FOR COL 80. IF COL 80 IS NON-BLANK THE PROG EXPECTS  VHC24200
C      ANOTHER COMPLETE DATA CASE TO FOLLOW. IF BLANK THE PROG ASSUMES   VHC24300
C      END OF DATA AFTER THE NEXT TWO CARDS.                            VHC24400
C-DATA CARD N+2 TO N+1+NSPECL (THESE NSPECL DATA CARDS ARE READ AFTER   VHC24500
C       THE CARD THAT SIGNIFIES THE END OF THE LAYER MET DATA.           VHC24600
C          (NSPECL CARDS, COL 1-80, 13A6,A2 FORMAT PER CARD)             VHC24700
C      EXTR - ARRAY OF A MAXIMUM OF 400 CHARACTERS, THIS ARRAY IS USED TOVHC24800
C           INPUT DATA VARIABLES FOR USE IN THE MAIN MULTILAYER MODEL    VHC24900
C           THAT ARE NOT USED IN THE PREPROCESSOR. THE PROGRAM READS     VHC25000
C           THIS ARRAY AND INSERTS IT INTO THE PREPROCESSOR PUNCH        VHC25100
C           OUTPUT. ANY VARIABLE ENTERED INTO THIS ARRAY WILL OVERRIDE   VHC25200
C           THE EQUIVALENT VALUE PRODUCED BY THE PREPROCESSOR. THE       VHC25300
C           DATA ITEMS INPUT INTO THE ARRAY EXTR ARE PUNCHED EXACTLY     VHC25400
C           AS IF THEY WERE TO BE INCLUDED IN AN INPUT NAMELIST DECK TO  VHC25500
C           THE MAIN MODEL EXCEPT THEY CANNOT INCLUDE $NAM2 OR $END.     VHC25600
C           EXAMPLE - IF WE WANT TO USE A SPECIAL GRID SYSTEM RATHER     VHC25700
C           THAN THE MAIN MODEL DEFAULT WE WOULD INPUT THE FOLLOWING     VHC25800
C           DATA BEGINING IN COL 2.                                      VHC25900
C           NXS=10,XX=1000,2000,3000,4000,5000,6000,7000,8000,9000,      VHC26000
C           10000,                                                       VHC26100
```

```
C            THIS DATA WOULD CHANGE THE AXIS RADIAL DISTANCES TO THESE  VHC26200
C            NEW VALUES FOR THIS CASE RUN.  IF SUBSEQUENT CASES ARE NOT VHC26300
C            GOING TO USE THESE VALUES OR IF THE DEFAULT AXIS IS TO BE  VHC26400
C            USED THESE VALUES MUST BE CHANGED TO THE DESIRED VALUES OR VHC26500
C            NXS MUST BE SET TO 0 ON THE NEXT CASE TO GET THE DEFAULT AXVHC26600
C            IF NSPECL IS 0 THIS DATA CARD(S) IS NOT READ               VHC26700
C                                                                       VHC26800
C     INITIALIZE CORE TO ZERO                                           VHC26900
    5 DO 10 I=1,161                                                     VHC27000
      I1(I) = 0                                                         VHC27100
      IF (I .GT. 142) GO TO 10                                          VHC27200
      I5(I) = 0                                                         VHC27300
      IF (I .GT. 61) GO TO 10                                           VHC27400
      I3(I) = 0                                                         VHC27500
      IF (I .GT. 44) GO TO 10                                           VHC27600
      I6(I) = 0                                                         VHC27700
      IF (I .GT. 12) GO TO 10                                           VHC27800
      I2(I) = 0                                                         VHC27900
      IF (I .GT. 13) GO TO 10                                           VHC28000
      I4(I) = 0                                                         VHC28100
   10 CONTINUE                                                          VHC28200
C                                                                       VHC28300
C                  *** PROGRAM CONSTANTS ***                            VHC28400
C     QC1-TOTAL SOURCE OUTPUT RATE IN GRAMS/SEC FOR A NORMAL LAUNCH     VHC28500
C     QT1- TOTAL SOURCE STRENGTH IN GRAMS FOR NORMAL LAUNCH             VHC28600
C     QC2 - TOTAL SOURCE OUTPUT RATE IN GRAMS/SEC FOR AN ABNORMAL LAUNCHVHC28700
C           WITH ONE ENGINE BURNING ON PAD                              VHC28800
C     QT2 - TOTAL SOURCE STRENGTH IN GRAMS FOR AN ABNORMAL LAUNCH WITH  VHC28900
C           ONE ENGINE BURNING ON PAD                                   VHC29000
C     QC3 - TOTAL SOURCE OUTPUT RATE IN GRAMS/SEC FOR AN ABNORMAL LAUNCHVHC29100
C           WHERE ENGINES EXPLODE AND BURN ON GROUND                    VHC29200
C     QT3 - TOTAL SOURCE STRENGTH IN GRAMS FOR AN ABNORMAL LAUNCH WHERE VHC29300
C           THE ENGINES EXPLODE AND BURN ON GROUND                      VHC29400
C     AA AND BB - ROCKET RISE PARAMETERS IN EQUATION TR=AA*Z**BB        VHC29500
C     HEATN - HEAT OUTPUT (CAL/G) NORMAL LAUNCH                         VHC29600
C     HEATM - HEAT OUTPUT (CAL/G) ABNORMAL LAUNCH WITH SINGLE ENGINE    VHC29700
C             BURN                                                      VHC29800
C     HEATA - HEAT OUTPUT (CAL/G) ABNORMAL LAUNCH WITH SLOW BURN ON PAD VHC29900
```

```
305*      C      GAMMAI - ENTRAINMENT PARAMETER FOR NORMAL LAUNCH                    VHC30000
306*             GAMMAI = 0.64                                                       VHC30100
307*      C      GAMMAC - ENTRAINMENT PARAMETER FOR ABNORMAL LAUNCH                  VHC30200
308*             GAMMAC = 0.5                                                        VHC30300
309*             GAMMAX = 0.0                                                        VHC30400
310*             GAMMAY = 0.0                                                        VHC30500
311*             GAMMAZ = 0.0                                                        VHC30600
312*      C      FRQ - FRACTIONAL DISTRIBUTION OF MATERIAL FOR HCL, CO, CO2, AL2O3   VHC30700
313*      C      WTMOL - MOLECULAR WEIGHTS OF HCL, CO, CO2                           VHC30800
314*             WTMOL(1) = 36.46                                                    VHC30900
315*             WTMOL(2) = 28.01                                                    VHC31000
316*             WTMOL(3) = 44.01                                                    VHC31100
317*      C      G - ACCELERATION OF GRAVITY (M/SEC SQUARE)                          VHC31200
318*             G = 9.8                                                             VHC31300
319*      C      CP - SPECIFIC HEAT OF AIR                                           VHC31400
320*             CP = 0.24                                                           VHC31500
321*      C      PI - RADIANS IN 180 DEGREES                                         VHC31600
322*             PI = 3.1415926                                                      VHC31700
323*             NDI = 69                                                            VHC31800
324*             NCI = 69                                                            VHC31900
325*             DO 12 I=1,10                                                        VHC32000
326*          12 ISKIP(I) = 0                                                        VHC32100
327*             NPS = 0                                                             VHC32200
328*      C                                                                          VHC32300
329*      C ** CARD 1                                                                VHC32400
330*             READ 1002, NAMCAS                                                   VHC32500
331*             DO 15 I=1,12                                                        VHC32600
332*             IF (NAMCAS(1) .NE. IBLK) GO TO 17                                   VHC32700
333*          15 CONTINUE                                                            VHC32800
334*             DO 16 I=1,12                                                        VHC32900
335*          16 NAMCAS(I) = NAMT(I)                                                 VHC33000
336*          17 DO 18 I=1,12                                                        VHC33100
337*          18 NAMT(I) = NAMCAS(1)                                                 VHC33200
338*      C                                                                          VHC33300
339*      C ** CARD 2                                                                VHC33400
340*             READ 1000, NSPECL,VEHICL,NORMAL,FEET,KNOTS,(DATE(I),I=1,5),TPROP,   VHC33500
341*            1SIGAR,RHO,ZSP,ISW                                                  VHC33600
342*             IF (ISW(12) .GT. 0) ISKIP(1) = ISW(12)                              VHC33700
```

```
      IF (ISW(13) .GT. 0) ISKIP(2) = ISW(13)                                VHC33800
      IF (ISW(14) .GT. 0) ISKIP(3) = ISW(14)                                VHC33900
C                                                                           VHC34000
C ** CARD 3 (OPTIONAL)                                                      VHC34100
      IF (ISW(8) .EQ. 1) READ 1006, GAMMAX,GAMMAY,GAMMAZ                    VHC34200
C                                                                           VHC34300
C ** CARD 4                                                                 VHC34400
      READ 1003, METUNT,(METDAT(I),I=1,3),NSND,IOUNT                        VHC34500
      IF (METUNT .EQ. 0) METUNT = 5                                         VHC34600
      IF (IOUNT .EQ. 0) IOUNT = 10                                          VHC34700
      K = 1                                                                 VHC34800
C                                                                           VHC34900
C   IF NAMELIST IS TO BE OUTPUT TO CARDS (UNIT 7), BRANCH                   VHC35000
      IF (IOUNT .EQ. 7) GO TO 24                                            VHC35100
C                                                                           VHC35200
C   IF THIS ISN'T THE FIRST TIME THROUGH, BRANCH                            VHC35300
      IF (ISTART .NE. 0) GO TO 24                                           VHC35400
      DEFINE FILE 10(100000,80,L,IASV)                                      VHC36000
      ISTART = 1                                                            VHC36100
C                                                                           VHC36200
C****                                                                       *VHC36300
C   SPECIAL CODE TO INCLUDE WHEN NO MASTER FILE FOR                         VHC36400
C   NAMELIST AND DIRECTORY ARE USED (I.E., NO TAPE COPIED)                  VHC36500
C                                                                           VHC36600
      WRITE (12,2012) (IZERO,I=1,9)                                         VHC36700
C                                                                           VHC36800
      END FILE 12                                                           VHC36900
      END FILE 12                                                           VHC37000
      REWIND 12                                                             VHC37100
C                                                                           VHC37200
C****                                                                       *VHC37300
C   READ THROUGH DIRECTORY FOR THE END OF FILE INDICATOR(IZERO)             VHC37400
   19 ISTRT = ISTRTC                                                        VHC37500
      IEND = IENDC                                                          VHC37600
      READ (12,2012) NVHCLC,(METDTC(J),J=1,3),NSNDC,NMODLC,NPLNTC,          VHC37700
     1ISTRTC,IENDC                                                          VHC37800
      IF (NVHCLC .NE. IZERO) GO TO 19                                       VHC37900
C   POSITION 12 FOR NEXT ENTRY                                              VHC38000
```

```
      BACKSPACE 12                                                              VHC38100
C  POSITION 10 FOR NEXT NAMELIST SET                                           VHC38200
      IASV = IEND+1                                                             VHC38300
C                                                                               VHC38400
      IERR = 0                                                                  VHC38500
      IF (METUNT .EQ. 5) GO TO 24                                               VHC38600
C                                                                               VHC38700
CC    CALL METIN(IERR)      - FOR READING FROM MET. TAPE                        VHC38800
C                                                                               VHC38900
      IF (IERR .EQ. 0) GO TO 22                                                 VHC39000
C  ERROR IN READING MET. TAPE                                                   VHC39100
   24 IF (JSWS .GT. 0.AND.LAMBDA .LE. 0.0) JSWS = 0                             VHC39200
      TIM1 = 0.0                                                                VHC39300
      LAMBDA = 0.0                                                              VHC39400
      RAINRT = 0.0                                                              VHC39500
      ZLIM = 0.0                                                                VHC39600
      DURAT = 0.0                                                               VHC39700
      IF (ISW(1) .LT. 2.AND.ISW(2) .LT. 2) GO TO 20                             VHC39800
C                                                                               VHC39900
C ** CARD 5 (OPTIONAL)                                                          VHC40000
      READ 1001, RAINRT,LAMBDA,TIM1,ZLIM,DURAT                                  VHC40100
C                                                                               VHC40200
C ** CARD 6 THROUGH N+1                                                         VHC40300
   20 READ 1001, Z(K),WD(K),WS(K),T(K),P(K),RH(K),IHM                           VHC40400
      IF (IHM .EQ. IAST) HM = Z(K)                                              VHC40500
C     MAKE SURE THAT K DOES NOT EXCEED ITS RANGE (20 VALUES, PLUS 1 FOR         VHC40600
C     WORK SPACE)                                                               VHC40700
      IF (K .LT. 21) GO TO 23                                                   VHC40800
      K = K-1                                                                   VHC40900
      IF (IHM .EQ. IAST) HM = Z(K)                                              VHC41000
      IF (Z(K+1)+WS(K+1)) 21,28,21                                              VHC41100
   28 CONTINUE                                                                  VHC41200
      K = K+1                                                                   VHC41300
      GO TO 22                                                                  VHC41400
   23 CONTINUE                                                                  VHC41500
      IF (Z(K)+WS(K)) 21,22,21                                                  VHC41600
   21 K = K+1                                                                   VHC41700
      GO TO 20                                                                  VHC41800
```

```
419*        22 NZS = K-1                                                    VHC41900
420*     C                                                                  VHC42000
421*     C  COMPUTE BURN RATE FACTOR DUE TO INITIAL PROPELLANT TEMPERATURE  VHC42100
422*     C                                                                  VHC42200
423*           IMONTH = METDAT(1)                                           VHC42300
424*           RFACT = 1.0                                                  VHC42400
425*           IF (IMONTH .EQ. 0) GO TO 27                                  VHC42500
426*           IF (TPROP-0.0) 26,25,26                                      VHC42600
427*        25 TPROP = AVTEMP(IMONTH)                                       VHC42700
428*        26 RFACT = 0.001*(TPROP-70.0)+1.0                               VHC42800
429*        27 CONTINUE                                                     VHC42900
430*           SIGAP(1) = 0.5*SIGAR                                         VHC43000
431*           IPNPS = 4                                                    VHC43100
432*           IF (ISW(5) .GT. 0)GO TO 30                                   VHC43200
433*           IPNPS = 3                                                    VHC43300
434*           IF (ISW(6) .GT. 0)GO TO 30                                   VHC43400
435*           IPNPS = 2                                                    VHC43500
436*           IF (ISW(4) .GT. 0) GO TO 30                                  VHC43600
437*           IPNPS = 1                                                    VHC43700
438*        30 CONTINUE                                                     VHC43800
439*     C ** CARD N+2 TO N+1+NSPECL                                        VHC43900
440*           IF (NSPECL .LE. 0) GO TO 38                                  VHC44000
441*           J = NSPECL*14                                                VHC44100
442*           READ 1002, (EXTR(I),I=1,J)                                   VHC44200
443*        38 CONTINUE                                                     VHC44300
444*     C     ZRK - HEIGHT AT WHICH SIGAR IS MEASURED (METERS)             VHC44400
445*           ZRK = Z(1)                                                   VHC44500
446*           IF (NORMAL .EQ. IBLK) NORMAL = YES                           VHC44600
447*           IF (VEHICL .EQ. TYPE(1)) GO TO 40                            VHC44700
448*           IF (VEHICL .EQ. TYPE(2)) GO TO 41                            VHC44800
449*           IF (VEHICL .EQ. TYPE(3)) GO TO 42                            VHC44900
450*           IF (VEHICL .EQ. TYPE(4)) GO TO 43                            VHC45000
451*           IF (VEHICL .EQ. TYPE(5)) GO TO 44                            VHC45100
452*           PRINT 2009                                                   VHC45200
453*        40 JV = 1                                                       VHC45300
454*           GO TO 50                                                     VHC45400
455*        41 JV = 2                                                       VHC45500
456*           ISW(6) = 0                                                   VHC45600
```

```
457*          GO TO 50                                                  VHC45700
458*       42 JV = 3                                                    VHC45800
459*          ISW(6) = 0                                                VHC45900
460*          IF (NORMAL .EQ. NO1) NORMAL = NO2                         VHC46000
461*          GO TO 50                                                  VHC46100
462*       43 JV = 4                                                    VHC46200
463*          ISW(6) = 0                                                VHC46300
464*          IF (NORMAL .EQ. NO1) NORMAL = NO2                         VHC46400
465*          GO TO 50                                                  VHC46500
466*       44 JV = 5                                                    VHC46600
467*          ISW(6) = 0                                                VHC46700
468*          IF (NORMAL .EQ. NO1) NORMAL = NO2                         VHC46800
469*       50 IF (JV .NE. 4) GO TO 51                                   VHC46900
470*          IF (NORMAL .NE. YES) GO TO 53                             VHC47000
471*       51 DO 52 I=1,4                                               VHC47100
472*       52 FRQ(I) = FRQ1(I,JV)                                       VHC47200
473*          GO TO 55                                                  VHC47300
474*       53 DO 54 I=1,4                                               VHC47400
475*       54 FRQ(I) = FRQ2(I)                                          VHC47500
476*       55 CONTINUE                                                  VHC47600
477*          IF (IFEET .EQ. IBNK) IFEET = NMS                          VHC47700
478*          IF (KNOTS .EQ. IBNK) KNOTS = NMS                          VHC47800
479*          IF (NORMAL .EQ. YES) GO TO 63                             VHC47900
480*          IF (NORMAL .EQ. NO1) GO TO 61                             VHC48000
481*          IF (NORMAL .EQ. NO2) GO TO 60                             VHC48100
482*          PRINT 2006, NORMAL                                        VHC48200
483*          GO TO 500                                                 VHC48300
484*       60 QC = QC3(JV)*RFACT                                        VHC48400
485*          QT = QT3(JV)                                              VHC48500
486*          IOM = 7                                                   VHC48600
487*          HEAT = HEATA(JV)                                          VHC48700
488*          ISKIP(6) = 4                                              VHC48800
489*          GO TO 62                                                  VHC48900
490*       61 QC = QC2(JV)*RFACT                                        VHC49000
491*          QT = QT2(JV)                                              VHC49100
492*          IOM = 4                                                   VHC49200
493*          HEAT = HEATM(JV)                                          VHC49300
494*          ISKIP(6) = 3                                              VHC49400
```


25

```
495*          62 NORMAL = 0                                                                    VHC49500
496*             IF (GAMMAX .LE. 0.0) GAMMAX = GAMMAC                                          VHC49600
497*             IF (GAMMAY .LE. 0.0) GAMMAY = GAMMAC                                          VHC49700
498*             IF (GAMMAZ .LE. 0.0) GAMMAZ = GAMMAC                                          VHC49800
499*             IF (ABS(GAMMAX*GAMMAY-0.25) .LT. 1.0E-6) GO TO 64                             VHC49900
500*             PRINT 2011                                                                    VHC50000
501*             GO TO 64                                                                      VHC50100
502*          63 GC = GC1(JV)*REACT                                                            VHC50200
503*             GT = GT1(JV)                                                                  VHC50300
504*             IJM = 1                                                                       VHC50400
505*             IF (GAMMAX .LE. 0.0) GAMMAX = GAMMAI                                          VHC50500
506*             IF (GAMMAY .LE. 0.0) GAMMAY = GAMMAI                                          VHC50600
507*             IF (GAMMAZ .LE. 0.0) GAMMAZ = GAMMAI                                          VHC50700
508*             IF (ABS(GAMMAX*GAMMAY*GAMMAZ-.262144) .GE. 1.0E-6) PRINT 2011                 VHC50800
509*             HEAT = HEATIN(JV)                                                             VHC50900
510*             NORMAL = 1                                                                    VHC51000
511*             ISKIP(6) = 2                                                                  VHC51100
512*          64 CONTINUE                                                                      VHC51200
513*             A = AA(JV)                                                                    VHC51300
514*             B = BB(JV)                                                                    VHC51400
515*             C = CC(JV)                                                                    VHC51500
516*             N = 3*JV-2                                                                    VHC51600
517*             M = N+2                                                                       VHC51700
518*             DO 65 I=1,3                                                                   VHC51800
519*             J = IJM+I-1                                                                   VHC51900
520*          65 LNTL(I) = LNCH(J)                                                             VHC52000
521*             J = 3                                                                         VHC52100
522*             DO 66 I=N,M                                                                   VHC52200
523*             J = J+1                                                                       VHC52300
524*          66 LNTL(J) = TYPES(1)                                                            VHC52400
525*             LNTL(7) = LNCH(10)                                                            VHC52500
526*             LNTL(8) = LNCH(11)                                                            VHC52600
527*             IF (HM .GT. 0.0) GO TO 70                                                     VHC52700
528*             HM = Z(NZS)                                                                   VHC52800
529*          70 CONTINUE                                                                      VHC52900
530*             PRINT 2005, (LNTL(J),J=1,8)                                                   VHC53000
531*             CALL CONST(0,NO,YES,IPOL,ITP,IFEET,KNOTS,ISW(8),TPROP)                        VHC53100
532*       C     CONVERT FEET TO METERS IF IFEET = F                                           VHC53200
```

```
533*            IF (ISW(1) .LT. 2.AND.ISW(2) .LT. 2) GO TO 73                    VHC53300
534*            ISW(4) = 0                                                       VHC53400
535*            ISW(5) = 0                                                       VHC53500
536*            ISW(6) = 0                                                       VHC53600
537*            IF (ZLIM .LE. 0.0) ZLIM = HM                                     VHC53700
538*            JSWS = ISW(1)                                                    VHC53800
539*            IF (DURAT .LE. 0.0)DURAT = 1.0                                   VHC53900
540*            IF (RAINRT .LE. 0.0) RAINRT = 0.3                                VHC54000
541*            IF (LAMBDA .LE. 0.0) LAMBDA = 5.2E-4*RAINRT**0.567               VHC54100
542*            IF (ISW(11) .EQ. 1) ISKIP(4) = 1                                 VHC54200
543*         73 CONTINUE                                                         VHC54300
544*            IF (IFEET .NE. ITP(1)) GO TO 76                                  VHC54400
545*            ZLIM = ZLIM*.3048                                                VHC54500
546*            DO 75 K=1,NZS                                                    VHC54600
547*         75 Z(K) = Z(K)*.3048                                                VHC54700
548*            HM = HM*.3048                                                    VHC54800
549*            ZRK = ZRK*.3048                                                  VHC54900
550*            ZSP = ZSP*.3048                                                  VHC55000
551*         76 CONTINUE                                                         VHC55100
552*      C     CONVERT KNOTS TO METERS/SEC IF KNOTS = K                         VHC55200
553*            IF (KNOTS .NE. ITP(2)) GO TO 78                                  VHC55300
554*            DO 77 K=1,NZS                                                    VHC55400
555*         77 WS(K) = WS(K)*.514791                                            VHC55500
556*         78 CONTINUE                                                         VHC55600
557*         80 DO 81 K=1,NZS                                                    VHC55700
558*            IF (Z(K)-1.0 .LT. HM.AND.HM .LT. Z(K)+1.0) GO TO 82              VHC55800
559*         81 CONTINUE                                                         VHC55900
560*            GO TO 400                                                        VHC56000
561*         82 KS = K                                                           VHC56100
562*      C     CONVERT TEMPERATURE FROM DEGREES CELSIUS TO ABSOLUTE             VHC56200
563*            DO 90 K=1,NZS                                                    VHC56300
564*         90 T(K) = T(K)+273.16                                               VHC56400
565*      C     CALCULATE VIRTUAL POTENTIAL TEMPERATURE                          VHC56500
566*            DO 100 K=1,NZS                                                   VHC56600
567*            XT = 1.0-373.16/T(K)                                             VHC56700
568*            XT = 1013.25*EXP(XT*(13.3185+XT*(-1.976+XT*(-.6445-.1299*XT))))  VHC56800
569*            XT = RH(K)*.01*XT                                                VHC56900
570*            XT = 0.622*XT/(P(K)-XT)                                          VHC57000
```


27

```
571*            XT = T(K)*(1.0+1.61*XT)/(1.0+XT)                        VHC57100
572*          100 TV(K) = CPH1(XT,P(K))                                 VHC57200
573*      C       CALCULATE PLUME RISE                                  VHC57300
574*              IF (NORMAL .EQ. 0) GO TO 120                          VHC57400
575*              CALL PLUME1                                           VHC57500
576*              IF (IFLG .GT. 0) GO TO 410                            VHC57600
577*              IF (JV .NE. 3.AND.JV .NE. 5) GO TO 130                VHC57700
578*              ZMSV = ZM                                             VHC57800
579*              GAMMAX = GAMMAC                                       VHC57900
580*              GAMMAY = GAMMAC                                       VHC58000
581*              GAMMAZ = GAMMAC                                       VHC58100
582*          120 CONTINUE                                              VHC58200
583*              CALL PLUME2                                           VHC58300
584*              IF (IFLG .GT. 0) GO TO 410                            VHC58400
585*              IF (JV .NE. 3.AND.JV .NE. 5) GO TO 130                VHC58500
586*              IF (NORMAL .EQ. 0) GO TO 130                          VHC58600
587*              GAMMAX = 0.5*(GAMMA1+GAMMAC)                          VHC58700
588*              GAMMAY = GAMMAX                                       VHC58800
589*              GAMMAZ = GAMMAX                                       VHC58900
590*              ZM = .5*(ZM+ZMSV)                                     VHC59000
591*              DO 121 I=2,NZS                                        VHC59100
592*              IF (ZM .LT. Z(I)) GO TO 122                           VHC59200
593*          121 CONTINUE                                              VHC59300
594*          122 CALL LEAST(Z,TV,DPDZ,1,0,0.0,0.0)                     VHC59400
595*              IF (DPDZ .LT. 3.322E-4) DPDZ = 3.322E-4               VHC59500
596*          130 CONTINUE                                              VHC59600
597*              IF (ISW(7) .NE. 0) CALL DELTXY                        VHC59700
598*      C       CALCULATE TURBULENCE PARAMETERS                       VHC59800
599*              CALL TURB                                             VHC59900
600*      C       CALCULATE SOURCE DISTRIBUTION FOR MODEL 4             VHC60000
601*              CALL DIST4(ISW(8))                                    VHC60100
602*      C       CALCULATE SOURCE DIMENSIONS FOR MODEL 4               VHC60200
603*              IFLG = 1                                              VHC60300
604*              CALL DIM34                                            VHC60400
605*              JBOT = 1                                              VHC60500
606*              NNZ = NZS-1                                           VHC60600
607*              JTOP = KS-1                                           VHC60700
608*              J = 4                                                 VHC60800
```

```
      IF (ISW(1) .EQ. 2) J = 54                                          VHC60900
      DO 131 I=JBOT,JTOP                                                 VHC61000
  131 IZMOD(I) = J                                                       VHC61100
      IF (JTOP .GE. NNZ) GO TO 134                                       VHC61200
      J = JTOP+1                                                         VHC61300
      N1 = 0                                                             VHC61400
      IF (ISW(10) .EQ. 0.AND.ZSP .LE. Z(JTOP+1)) GO TO 132               VHC61500
      IZMOD(J) = 94                                                      VHC61600
      J = J+1                                                            VHC61700
      IF (J .GT. NNZ) GO TO 134                                          VHC61800
      N1 = 4                                                             VHC61900
  132 DO 133 I=J,NNZ                                                     VHC62000
  133 IZMOD(I) = N1                                                      VHC62100
  134 CONTINUE                                                           VHC62200
      XX = 1.0E3*22.4*1013.2*T(1)/(273.16*P(1))                          VHC62300
      I1 = 4                                                             VHC62400
C     OUTPUT NAMELIST NAM2 FOR HCL, CO, CO2, AL2O3 MODEL 4               VHC62500
      ISKIP(9) = 0                                                       VHC62600
      IF (ISW(1) .EQ. 2.AND.ISW(9) .EQ. 0) ISKIP(9) = 0                  VHC62700
      IF (ISW(1) .EQ. 2.AND.ISW(9) .EQ. 1) ISKIP(9) = 1                  VHC62800
      DO 200 I=1,4                                                       VHC62900
      DO 151 K=1,NNZ                                                     VHC63000
  151 QF(K,I) = 0.0                                                      VHC63100
      ISKIP(5) = 1                                                       VHC63200
      NTI = 61                                                           VHC63300
      IF (I .EQ. 1) NTI = 62                                             VHC63400
      IF (I .EQ. 3) NTI = 69                                             VHC63500
      IF (ISW(1) .NE. 2) GO TO 135                                       VHC63600
      NTI = 0                                                            VHC63700
      NCI = 0                                                            VHC63800
  135 CONTINUE                                                           VHC63900
      DO 138 J=1,10                                                      VHC64000
      IF (I .GT. 1.OR.ISW(9) .EQ. 0) GO TO 136                           VHC64100
      D1(J) = DDIP(J)                                                    VHC64200
      GO TO 137                                                          VHC64300
  136 D1(J) = DDI(J,I)                                                   VHC64400
  137 T1(J) = TTI(J,I)                                                   VHC64500
      C1(J) = CCI(J,I)                                                   VHC64600
```

```
      IF (ISW(1) .NE. 2) GO TO 138                                          VHC64700
      C1(J) = 0.0                                                           VHC64800
      T1(J) = 0.0                                                           VHC64900
  138 CONTINUE                                                              VHC65000
C     CALCULATE CONVERSTION FACTOR TO PPM FOR HCL, CO, CO2 AND TO           VHC65100
C     MILLIGRAMS PER CUBIC METER FOR AL2O3 AND ADJ FOR PERCENT OF MAT.      VHC65200
      IF (ISW(1) .EQ. 2) GO TO 142                                          VHC65300
      IF (I .EQ. 4) GO TO 140                                               VHC65400
      QK = (XX/WTMOL(I))*FRG(I)                                             VHC65500
      GO TO 150                                                             VHC65600
  140 QK = 1.0E3*FRG(I)                                                     VHC65700
      GO TO 150                                                             VHC65800
  142 IF (I .GT. 1) GO TO 161                                               VHC65900
      IF (ISW(9) .EQ. 0) GO TO 140                                          VHC66000
      QK = 1.0/(RAINRT*25.4*WTMOL(I)*DURAT)                                 VHC66100
      IF (ISW(11) .EQ. 1) QK = QK*DURAT                                     VHC66200
C     CONVERT Q TO PROPER UNITS AND PERCENTAGE OF POLLUTANT                 VHC66300
  150 DO 160 K=1,NNZ                                                        VHC66400
      XFT = QK*W(K)                                                         VHC66500
  160 QF(K,I) = XFT                                                         VHC66600
  161 CONTINUE                                                              VHC66700
      IF (ISW(1) .EQ. 0) GO TO 20                                           VHC66800
      IF (ISW(3) .EQ. 0.AND.I .EQ. 1) GO TO 200                             VHC66900
      IF (ISW(4) .EQ. 0 .AND.I .EQ. 2) GO TO 200                            VHC67000
      IF (ISW(5) .EQ. 0.AND.I .EQ. 4) GO TO 200                             VHC67100
      IF (ISW(6) .EQ. 0.AND.I .EQ. 3) GO TO 200                             VHC67200
      PRINT 2005,NAMCAS,(LNTL(J),J=1,8)                                     VHC67300
      PRINT 2007                                                            VHC67400
      K = 1                                                                 VHC67500
      IF (I .EQ. 4) K = 3                                                   VHC67600
      IF (ISW(2) .GT. 0) GO TO 170                                          VHC67700
      IF (IHR .NE. IBNK) GO TO 170                                          VHC67800
      IF (I .EQ. IPNPS) NPS = 1                                             VHC67900
  170 CONTINUE                                                              VHC68000
      NVHCL = JV                                                            VHC68100
      NMOOL = 4                                                             VHC68200
      IF (ISW(1) .EQ. 2) NMOOL = 54                                         VHC68300
      NPLNT = I                                                             VHC68400
```

```
      WRITE (6,2002) (TYPES(J),J=N,M),IPOL(1),NMODL                          VHC68500
      WRITE (6,2010) METUNT,(METDAT(J),J=1,3),NSND,IOUNT                     VHC68600
      DATE(6) = BLKS                                                         VHC68700
      PRINT 2001, (DATE(J),J=1,6),(TYPES(J),J=N,M)                           VHC68800
      ISTRT = IASV                                                           VHC68900
      IF (IOUNT .NE. 7) WRITE(IOUNT'IASV,2001) (DATE(J),J=1,6),(TYPES(J)     VHC69000
     1,J=N,M)                                                                VHC69100
      IF (IOUNT .EQ. 7) PUNCH 2001, (DATE(J),J=1,6),(TYPES(J),J=N,M)         VHC69200
  180 CALL OUTPT(KS,I,4,ISTRT,ISW(10),ZSP)                                   VHC69300
  200 CONTINUE                                                               VHC69400
      IF (ISW(1) .EQ. 0) GO TO 205                                           VHC69500
      PRINT 2005, NAMCAS,(LNTL(J),J=1,8)                                     VHC69600
      CALL CONST(4,NO,YES,IPOL,ITP,IFLET,KNOTS,ISW(8),TPROP)                 VHC69700
  205 CONTINUE                                                               VHC69800
C     OUTPUT NAMELIST NAM2 FOR HCL, CO, CO2, AL203 MODEL 3                   VHC69900
C     CALCULATE SOURCE DISTRIBUTION FOR MODEL 3                              VHC70000
      CALL DIST3(ISW(6))                                                     VHC70100
C     CALCULATE SOURCE DIMENSIONS FOR MODEL 3                                VHC70200
      IFLG = 0                                                               VHC70300
      CALL DIM34                                                             VHC70400
      Z(2) = HM                                                              VHC70500
      SIGAP(2) = SIGAP(KS)                                                   VHC70600
      SIGEP(2) = SIGEP(KS)                                                   VHC70700
      WD(2) = WD(KS)                                                         VHC70800
      UBAR(2) = UBAR(KS)                                                     VHC70900
      IZMOD(1) = 3                                                           VHC71000
      IF (ISW(2) .EQ. 2) IZMOD(1) = 53                                       VHC71100
      DX(1) = DX(KS-1)                                                       VHC71200
      DY(1) = DY(KS-1)                                                       VHC71300
      IF (SIGZO(1) .LE. 0.0) GO TO 420                                       VHC71400
      NMZ = 1                                                                VHC71500
      NZS = 2                                                                VHC71600
      KS = 2                                                                 VHC71700
      II = 3                                                                 VHC71800
      ISKIP(9) = 0                                                           VHC71900
      IF (ISW(2) .EQ. 2.AND.ISW(9) .EQ. 0) ISKIP(9) = 0                      VHC72000
      IF (ISW(2) .EQ. 2.AND.ISW(9) .EQ. 1) ISKIP(9) = 1                      VHC72100
      DO 260 I=1,4                                                           VHC72200
```

```
      GF(1,I) = 0.0                                                    VHC72300
      ISKIP(5) = 1                                                     VHC72400
      NTI = 61                                                         VHC72500
      IF (I .EQ. 1) NTI = 62                                           VHC72600
      IF (I .EQ. 3) NTI = 69                                           VHC72700
      IF (ISW(2) .NE. 2) GO TO 207                                     VHC72800
      NTI = 0                                                          VHC72900
      NCI = 0                                                          VHC73000
  207 CONTINUE                                                         VHC73100
      DO 210 J=1,10                                                    VHC73200
      IF (I .GT. 1.OR.ISW(9) .EQ. 0) GO TO 208                         VHC73300
      DI(J) = DDIP(J)                                                  VHC73400
      GO TO 209                                                        VHC73500
  208 DI(J) = DDI(J,I)                                                 VHC73600
  209 TI(J) = TTI(J,I)                                                 VHC73700
      CI(J) = CCI(J,I)                                                 VHC73800
      IF (ISW(2) .NE. 2) GO TO 210                                     VHC73900
      TI(J) = 0.0                                                      VHC74000
      CI(J) = 0.0                                                      VHC74100
  210 CONTINUE                                                         VHC74200
C     CALCULATE CONVERSION FACTOR TO PPM FOR HCL, CO, CO2 AND TO       VHC74300
C     MILLIGRAMS PER CUBIC METER FOR AL2O3 AND ADJ FOR PERCENT OF MAT. VHC74400
      IF (ISW(2) .EQ. 2) GO TO 220                                     VHC74500
      IF (I .EQ. 4) GO TO 220                                          VHC74600
      GF(1,I) = G(1)*(XX/WTMOL(1))*FRQ(1)                              VHC74700
      GO TO 230                                                        VHC74800
  220 IF (ISW(2) .EQ. 2.AND.I .GT. 1) GO TO 231                        VHC74900
      QF(1,I) = Q(1)*1.0E3*FRQ(1)                                      VHC75000
      IF (ISW(2) .NE. 2) GO TO 230                                     VHC75100
      IF (ISW(9) .EQ. 0) GO TO 230                                     VHC75200
      QF(1,I) = Q(1)/(RAINRT*25.4*WTMOL(I)*DURAT)                      VHC75300
      IF (ISW(11) .EQ. 1) QF(1,I) = GF(1,I)*DURAT                      VHC75400
  230 CONTINUE                                                         VHC75500
  231 CONTINUE                                                         VHC75600
      IF (ISW(2) .EQ. 0) GO TO 260                                     VHC75700
      IF (ISW(3) .EQ. 0.AND.I .EQ. 1) GO TO 260                        VHC75800
      IF (ISW(4) .EQ. 0.AND.I .EQ. 2) GO TO 260                        VHC75900
      IF (ISW(5) .EQ. 0.AND.I .EQ. 4) GO TO 260                        VHC76000
```

```
761*           IF (ISW(6) .EQ. 0.AND.I .EQ. 3) GO TO 260                        VHC76100
762*           PRINT 2005,NAMCAS,(LNTL(J),J=1,8)                                VHC76200
763*           PRINT 2007                                                       VHC76300
764*           K = 1                                                            VHC76400
765*           IF (I .EQ. 4) K = 3                                              VHC76500
766*           IF (IHM .NE. IBNK) GO TO 240                                     VHC76600
767*           IF (I .EQ. IPNPS) NPS = 1                                        VHC76700
768*       240 CONTINUE                                                         VHC76800
769*           NVHCL = JV                                                       VHC76900
770*           NMODL = 3                                                        VHC77000
771*           IF (ISW(2) .EQ. 2) NMODL = 53                                    VHC77100
772*           JSWS = ISW(2)                                                    VHC77200
773*           NPLNT = I                                                        VHC77300
774*           WRITE (6,2002) (TYPES(J),J=N,M),IPOL(I),NMODL                    VHC77400
775*           WRITE (6,2010) METUNT,(METDAT(J),J=1,5),NSND,IOUNT               VHC77500
776*           DATE(6) = BLKS                                                   VHC77600
777*           PRINT 2001, (DATE(J),J=1,6),(TYPES(J),J=N,M)                     VHC77700
778*           ISTRT = IASV                                                     VHC77800
779*           IF (IOUNT .NE. 7) WRITE (IOUNT'IASV,2001) (DATE(J),J=1,6),(TYPES(JVHC77900
780*          1),J=N,M)                                                         VHC78000
781*           IF (IOUNT .EQ. 7) PUNCH 2001, (DATE(J),J=1,6),(TYPES(J),J=N,M)   VHC78100
782*       250 CALL OUTPT(KS,I,3,ISTRT,ISW(10),ZSP)                             VHC78200
783*       260 CONTINUE                                                         VHC78300
784*           IF (ISW(2) .EQ. 0) GO TO 500                                     VHC78400
785*           PRINT 2005, NAMCAS,(LNTL(J),J=1,8)                               VHC78500
786*           CALL CONST(3,NO,YES,IPOL,ITP,IFEET,KNOTS,ISW(8),TPROP)           VHC78600
787*           GO TO 500                                                        VHC78700
788*       400 PRINT 2003                                                       VHC78800
789*           GO TO 500                                                        VHC78900
790*       410 II = 2                                                           VHC79000
791*           IF (IFEET .NE. ITP(1)) GO TO 411                                 VHC79100
792*           II = 1                                                           VHC79200
793*           ZM = ZM/.3048                                                    VHC79300
794*       411 PRINT 2004, ZM,JP(II)                                            VHC79400
795*           GO TO 500                                                        VHC79500
796*       420 PRINT 2008                                                       VHC79600
797*       500 IF (IHM .NE. IBNK) GO TO 5                                       VHC79700
798*         C  ADD IZERO ON UNIT 12 TO INDICATE LAST RECORD                    VHC79800
```

```
      IF (IOUNT .EQ. 7) STOP                                                    VHC79900
      WRITE (12,2012) (IZERO,J=1,9)                                             VHC80000
      ENDFILE 12                                                                VHC80100
      ENDFILE 12                                                                VHC80200
      REWIND 12                                                                 VHC80300
      WRITE (6,2013)                                                            VHC80400
  510 CONTINUE                                                                  VHC80500
      READ (12,1002,END=520) NAMCAS                                             VHC80600
      WRITE (6,2014) NAMCAS                                                     VHC80700
      GO TO 510                                                                 VHC80800
  520 CONTINUE                                                                  VHC80900
      REWIND 12                                                                 VHC81000
      STOP                                                                      VHC81100
 1000 FORMAT (I1,2A3,2A1,5A6,2F6.0,F7.0,F8.0,14I1)                              VHC81200
 1001 FORMAT (6F10.0,19X,A1)                                                    VHC81300
 1002 FORMAT (13A6,A2)                                                          VHC81400
 1003 FORMAT (I2,2X,3I2,2X,I2,2X,I2)                                            VHC81500
 1006 FORMAT (3F4.2)                                                            VHC81600
 2001 FORMAT (6H $NAM2/11H TESTNO=60H,9A6,7H      ,)                           VHC81700
 2002 FORMAT (1H,3A6,10X,A6,10X,6HMODEL=,I2)                                    VHC81800
 2003 FORMAT (84H0 **ERROR** HM MUST BE EQUAL TO ONE OF THE LAYER BOUNDAVHC81900
     1RIES Z AND IN THE SAME UNITS./)                                           VHC82000
 2004 FORMAT  (70H0 **ERROR** NOT ENOUGH LAYERS, TOP OF LAST LAYER MUST VHC82100
     1BE GREATER THAN ,1PE12.5,1X,A6,19H, INPUT MORE LAYERS/)                   VHC82200
 2005 FORMAT (1H1,21X,8H*-*-*-* ,12A6,8H *-*-*-*/29X,8H*-*-*-* ,3A6,1X,5VHC82300
     1A6,6H *-*-*-*/)                                                           VHC82400
 2006 FORMAT (58H ***ERROR*** COLUMNS 1-3 ARE INCORRECTLY PUNCHED ON CARVHC82500
     1D 1)                                                                      VHC82600
 2007 FORMAT (28X,75H*-* NAMELIST NAM2 FOR INPUT TO THE NASA/MSFC MULTILVHC82700
     1AYER MODEL VERSION 5 *-*//)                                               VHC82800
 2008 FORMAT (102H1*-* CLOUD RISE IS WELL ABOVE HM. MODEL 3 PARAMETERS AVHC82900
     1RE NOT CALCULATED. USE MODEL 4 FOR THIS CASE *-*)                         VHC83000
 2009 FORMAT (54H *WARNING* VEHICLE TYPE NOT SPECIFIED, TITAN IIIC USED)VHC83100
 2010 FORMAT (1H ,7HMETUNT=,I2,5X,7HMETDAT=,I2,1H/,I2,1H/,I2,5X,17HHOUR VHC83200
     1OF SOUNDING=,I2,5X,28HIOUNT(NAMELIST OUTPUT UNIT)=,I2//)                  VHC83300
 2011 FORMAT(126H0 ***WARNING*** PRODUCT OF GAMMA'S IS NOT CORRECT, SEE VHC83400
     1NOTE ACCOMPANYING DEFINITION OF GAMMA'S FOR ELLIPTICALLY SHAPED SOVHC83500
     2URCES/)                                                                   VHC83600
```

```
037*      2012 FORMAT (I1,3I2,I2,I3,I1,2I6)                                VHC83700
038*      2013 FORMAT (1H1,26HDUMP OF NAMELIST DIRECTORY)                  VHC83800
039*      2014 FORMAT (1H ,12A6)                                           VHC83900
040*           END                                                         VHC84000
```

```
1*            SUBROUTINE CONST, VERSION 6,  REVISION 0
2*
3*            SUBROUTINE CONST(JFLG,NO,YES,IPOL,ITP,IFEET,KNOTS,ISWB,TPROP)      CST00100
4*            COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),CST00200
5*           1P(21),Z(21),UBAR(21),NZS,Q(20),QT,HN,SIGEP(21),SIGAP(21),G,TAUK,  CST00300
6*           2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                    CST00400
7*            COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS           CST00500
8*            COMMON /SIG/ SIGXO(20),SIGYO(20),SIGZO(20),H                       CST00600
9*            COMMON /F/ DATE(6),FRG(4),WTMOL(3)                                 CST00700
10*           COMMON /OUT/ GF(20,4),WD(21),ISKIP(10),NDI,NCI,NTI,ZRK,JBOT,JTOP,  CST00800
11*          1IZMOD(21),CI(10),DI(10),TI(10),NPS                                CST00900
12*           COMMON/DISPL/DXX,DX(21),DYY,DY(21),ILXY,TIMC(21)                   CST01000
13*           COMMON /PRECIP/ RAINRT,LAMBDA,TIM1,ZLIM,DURAT,JSWS,EXTR(70),NSPECLCST01100
14*           INTEGER EXTR                                                       CST01200
15*           REAL LAMBDA                                                        CST01300
16*           DIMENSION IFQ(4)                                                   CST01400
17*           DATA IFQ/24H FEET METERSKNOTS MET/S /                              CST01500
18*           DATA IBLK,IPH/1H ,3H PH/                                           CST01600
19*           DIMENSION IPOL(4)                                                  CST01700
20*           DIMENSION ITP(2)                                                   CST01800
21*           INTEGER YES                                                        CST01900
22*           IF (JFLG .GT. 0) GO TO 20                                          CST02000
23*           PRINT 2000, QC,QT,A,B,HEAT,CP                                      CST02100
24*     2000 FORMAT (1H0,41X,     47H*-* INITIALIZED DATA USED FOR ABOVE VEHICLCST02200
25*          1E *-*//20X,69HQC - RATE OF OUTPUT OF EXHAUST MATERIAL FROM VEHICLECST02300
26*          2 IN GRAMS/SEC IS ,1PE15.8/                                        CST02400
27*          320X,58HQT - TOTAL AMOUNT OF VEHICLE EXHAUST MATERIAL IN GRAMS IS ,CST02500
28*          4E15.8/                                                            CST02600
29*          520X,64HA AND B - VEHICLE RISE PARAMETERS IN THE EQUATION TR=A*Z**BCST02700
30*          6 ARE ,0PF8.6,5H AND ,F8.6/                                        CST02800
31*          720X,45HHEAT - TOTAL HEAT OUTPUT IN CALORIES/GRAM IS ,F10.4/       CST02900
32*          820X,29HCP - SPECIFIC HEAT OF AIR IS ,F5.3)                        CST03000
33*           PRINT 2008, GAMMAX,GAMMAY,GAMMAZ                                   CST03100
34*     2008 FORMAT (20X,36HGAMMAX - X ENTRAINMENT PARAMETER IS ,F7.4/           CST03200
35*          120X,36HGAMMAY - Y ENTRAINMENT PARAMETER IS ,F7.4/                  CST03300
36*          220X,36HGAMMAZ - Z ENTRAINMENT PARAMETER IS ,F7.4)                  CST03400
37*           PRINT 2001, IPOL,FRG,WTMOL                                         CST03500
38*     2001 FORMAT (20X,23HPOLUTANT MATERIALS ARE ,4(A6,1H,)/                   CST03600
```

```
39*          120X,50HFRACTIONAL DISTRIBUTION OF THE ABOVE MATERIALS IS ,4(F5.3, CST03700
40*          21H,)/                                                          CST03800
41*          320X,43HMOLECULAR WEIGHT OF THE ABOVE MATERIALS IS ,3(F7.3,1H,)  ) CST03900
42*           J1 = NO                                                        CST04000
43*           IF (NORMAL .EQ. 1) J1 = YES                                    CST04100
44*           J2 = NO                                                        CST04200
45*           IF (IFEET .EQ. ITP(1)) J2 = YES                                CST04300
46*           J3 = NO                                                        CST04400
47*           IF (KNOTS .EQ. ITP(2)) J3 = YES                                CST04500
48*           N1 = IFQ(2)                                                    CST04600
49*           IF (J2 .EQ. YES) N1 = IFQ(1)                                   CST04700
50*           N2 = IFQ(4)                                                    CST04800
51*           IF (J3 .EQ. YES) N2 = IFQ(3)                                   CST04900
52*           PRINT 2002, (DATE(I),I=1,5),J1,J2,J3,TPROP,SIGAR,RHO,HM        CST05000
53*      2002 FORMAT (1H0,52X,26H*-* PROGRAM INPUT DATA *-*//25X,11HDATA CARD 1/CST05100
54*          129X,8HTITLE - ,5A6/29X,28HNORMAL - IS LAUNCH NORMAL ? ,A3/     CST05200
55*          229X,54HIFEET - ARE LAYER BOUNDARY HEIGHTS Z, AND HM IN FEET? ,A3/ CST05300
56*          329X,39HKNOTS - IS THE WIND SPEED WS IN KNOTS? ,A3/             CST05400
57*          829X,77HTPROP - THE INITIAL TEMPERATURE OF THE PROPELLANT IN DEGREECST05500
58*          9S FAHRENHEIT IS   ,F6.1/                                       CST05600
59*          429X,67HSIGAR - STANDARD DEVIATION OF THE AZIMUTH WIND ANGLE IN DEGCST05700
60*          5REES IS ,F7.3/                                                 CST05800
61*          629X,42HRHO - AIR DENSITY IN GRAMS/CUBIC METER IS ,F9.3/        CST05900
62*          729X,39HHM -  DEPTH OF SURFACE MIXING LAYER IS ,F9.3)           CST06000
63*           IF (ISW8 .EQ. 0) PRINT 2009                                    CST06100
64*      2009 FORMAT (29X,25HSOURCE SHAPE IS SPHERICAL)                      CST06200
65*           IF (ISW8 .EQ. 1) PRINT 2010                                    CST06300
66*      2010 FORMAT (29X,26HSOURCE SHAPE IS ELLIPTICAL)                     CST06400
67*           PRINT 2011, NZS                                                CST06500
68*      2011 FORMAT (25X,20HDATA CARD 1 THROUGH ,I2/33X,67HLAYER BOUNDARY   WICST06600
69*          1D DIRECTION  WIND SPEED  TEMPERATURE   PRESSURE)               CST06700
70*           PRINT 2003, N1,N2                                              CST06800
71*      2003 FORMAT (39X,1HZ,1X,1H(,A6,1H),4X,9HWD  (DEG),5X,2HWS,1X,1H(,A5,1H)CST06900
72*          1,2X,9HT (DEG C),6X,6HP (Mb),3X,12HRH (PERCENT))                CST07000
73*           DO 10 I=1,NZS                                                  CST07100
74*        10 PRINT 2004, Z(I),WD(I),UBAR(I),T(I),P(I),RH(I)                 CST07200
75*      2004 FORMAT (34X,F9.3,9X,F9.4,4X,F9.4,5X,F9.3,3X,F9.3,5X,F7.3)      CST07300
76*           GO TO 40                                                       CST07400
```


37

```
 77*          20 CONTINUE                                                        CST07500
 78*             NMZ = NZS-1                                                     CST07600
 79*             ZZL = 0.0                                                       CST07700
 80*             N7 = JFLG                                                       CST07800
 81*             IF (JSWS .GT. 1) N7 = N7+50                                     CST07900
 82*             PRINT 2005, N7,H,ZM,TAUK,DPDZ,JBOT,JTOP,ZZL                     CST08000
 83*          2005 FORMAT (1H0,39X,36H*-* CALCULATED PARAMETERS FOR MODEL ,I2,4H *-*/CST08100
 84*             1/13X,39HH - ADJUSTED CLOUD HEIGHT IN METERS IS ,F9.3/          CST08200
 85*             213X,36HZM - REAL CLOUD HEIGHT IN METERS IS ,F9.3/              CST08300
 86*             313X,45HTAUK - TIME TO CLOUD STABILIZATION IN SEC IS ,F9.3/     CST08400
 87*             413X,73HDPDZ - VERTICAL GRADIENT OF AMBIENT POTENTIAL TEMP IN DEGRECST08500
 88*             5ES K/METER IS ,F12.6/                                          CST08600
 89*             613X,44HJBOT - BOTTOM LAYER FOR USE WITH MODEL 4 IS ,I2/         CST08700
 90*             713X,41HJTOP - TOP LAYER FOR USE WITH MODEL 4 IS ,I2/            CST08800
 91*             813X,58HZ - BOUNDARY HEIGHT AT THE BOTTOM OF LAYER 1 IN METERS IS ,CST08900
 92*             9F8.3)                                                          CST09000
 93*              IF (JSWS .LE. 1) GO TO 25                                      CST09100
 94*              J1 = YES                                                       CST09200
 95*              J2 = IBLK                                                      CST09300
 96*              IF (ISKIP(9) .EQ. 0) GO TO 24                                  CST09400
 97*              J1 = NO                                                        CST09500
 98*              J2 = IPH                                                       CST09600
 99*           24 PRINT 2012, RAINRT,LAMBDA,TIM1,ZLIM,DURAT,J1,J2                CST09700
100*         2012 FORMAT (13X,34HRAINRT - RAIN RATE IN IN./HOUR IS ,E12.6/       CST09800
101*             113X,51HLAMBDA - COEFFICIENT OF PRECIPITATION SCAVENGING IS,E12.6/ CST09900
102*             213X,42HTIM1 - TIME OF START OF PRECIP. IN SEC IS ,F6.2/        CST10000
103*             313X,46HZLIM - MAXIMUM HEIGHT OF PRECIP. IN METERS IS ,F7.2/    CST10100
104*             413X,39HDURAT - DURATION OF PRECIP. IN HOURS IS,F7.4/           CST10200
105*             513X,57HARE PRECIPITATION DEPOSITION OUTPUT UNITS TO BE MG/M**2 -,2CST10300
106*             6A3)                                                           CST10400
107*           25 CONTINUE                                                       CST10500
108*              PRINT 2006, ZRK,SIGAP(1),SIGEP(1),IPOL                         CST10600
109*         2006 FORMAT (13X,83HSIGAP - STANDARD DEVIATION OF THE WIND AZIMUTH ANGLCST10700
110*             1E AT THE MEASUREMENT HEIGHT ZRK=,F6.2,11H METERS IS ,F8.3/      CST10800
111*             213X,65HSIGEP - STANDARD DEVIATION OF THE WIND ELEVATION ANGLE AT ZCST10900
112*             3RK IS ,F8.3/19H LAYER PARAMETERS -/10H LAYER   2,17X,21H- SOURCE SCST11000
113*             4TRENGTH Q -,21X,59HSIGAP SIGEP  SIGXO   SIGYO   SIGZO    DELX   DECST11100
114*             5LY  CLD-RISE/12H  NO. (LAYER,56X,2(6H (DEG)),4(8H (METER)),14H  (DCST11200
```

```
     6E9)    TIME/6X,4HTOP),5X,A6,2(6X,A6),7X,A6,58X,5H(SEC)/)                CST11300
      DO 30 K=1,NNZ                                                           CST11400
   30 PRINT 2007, K,Z(K+1),(QF(K,I),I=1,4),SIGAP(K+1),SIGEP(K+1),SIGXO(K      CST11500
     1),SIGYO(K),SIGZO(K),DX(K),DY(K),TIMC(K)                                 CST11600
 2007 FORMAT (1X,I3,F8.1,1P4E14.7,0P2F6.2,3F8.3,F8.2,F7.2,F9.2)               CST11700
   40 CONTINUE                                                               CST11800
      RETURN                                                                 CST11900
      END                                                                    CST12000
```

```
1*            SUBROUTINE OUTPT, VERSION 6,  REVISION 0
2*
3*            SUBROUTINE OUTPT(NZ,I,IK,ISTRT,ISW10,ZSP)                                    OPT00100
4*            COMMON /PLUME/ UC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),OPT00200
5*           1P(21),Z(21),UBAR(21),NZS,G(20),UT,HM,SIGEP(21),SIGAP(21),G,TAUK,  OPT00300
6*           2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                     OPT00400
7*            COMMON /SIG/ SIGXO(20),SIGYO(20),SIGZO(20),H                        OPT00500
8*            COMMON /PRECIP/ RAINRT,LAMBDA,TAU1,ZLIM,DURAT,JSWS,EXTR(70),NSPECLOPT00600
9*            INTEGER EXTR                                                        OPT00700
10*           REAL LAMBDA                                                         OPT00800
11*           COMMON /OUT/ UF(20,4),WD(21),ISKIP(10),NDI,NCI,NTI,ZRK,JBOT,JTOP,  OPT00900
12*          1IZMOD(21),CI(10),DI(10),TI(10),NPS                                  OPT01000
13*           COMMON/DISPL/ DXX,DX(21),DYY,DY(21),ILXY,TIMC(21)                   OPT01100
14*           COMMON /CASCRD/ NVHCL,METDAT(3),NMODL,NPLNT,NSND,IOUNT,IASV         OPT01200
15*           DIMENSION GL(20),IG(20),JG(20),KG(20)                               OPT01300
16*           DIMENSION JE(15)                                                    OPT01400
17*           DIMENSION ZZL(3)                                                    OPT01500
18*           DATA JE/90H     Z     U UBARK SIGAK SIGEK SIGXO SIGYO SIGZOTHETAK  OPT01600
19*          1   DI    CI  DELX  DELY    TI TEMPK/                              OPT01700
20*           NZM = NZ                                                            OPT01800
21*           IF (IK .EQ. 4.AND.ZSP .GT. Z(NZ)) NZ = NZS                          OPT01900
22*           IF (IK .EQ. 4.AND.ISW10 .GT. 0) NZ = NZS                            OPT02000
23*           IF (NZ .GT. 16) NZ = 16                                             OPT02100
24*           NMZ = NZ-1                                                          OPT02200
25*           NDII = NDI/10                                                       OPT02300
26*           NCII = NCI/10                                                       OPT02400
27*           NTII = NTI/10                                                       OPT02500
28*           NPTS = 0                                                            OPT02600
29*           LSW1 = NSPECL*14                                                    OPT02700
30*           ZZL(1) = 0.0                                                        OPT02800
31*           ZZL(2) = 0.0                                                        OPT02900
32*           ZZL(3) = 0.0                                                        OPT03000
33*           IF (ISW10 .EQ. 1) GO TO 5                                           OPT03100
34*           NPTS = NPTS+1                                                       OPT03200
35*           ZZL(NPTS) = 0.0                                                     OPT03300
36*         5 IF (ZSP .LE. 0.0) GO TO 6                                           OPT03400
37*           NPTS = NPTS+1                                                       OPT03500
38*           ZZL(NPTS) = ZSP                                                     OPT03600
```

```
      6 IF (ISW10 .EQ. 0) GO TO 7                                                    OPT03700
        NPTS = NPTS+1                                                                OPT03800
        ZZL(NPTS) = H                                                                OPT03900
      7 IF (NPTS .EQ. 1) GO TO 8                                                     OPT04000
        IF (ZZL(NPTS) .GE. ZZL(NPTS-1)) GO TO 8                                      OPT04100
        ZT = ZZL(NPTS)                                                               OPT04200
        ZZL(NPTS) = ZZL(NPTS-1)                                                      OPT04300
        ZZL(NPTS-1) = ZT                                                             OPT04400
      8 CONTINUE                                                                     OPT04500
        ZF = 0.0                                                                     OPT04600
        TIMAV = 600.0                                                                OPT04700
        IF (I .EQ. 2) TIMAV = 360.0                                                  OPT04800
        PRINT 1999, NAMCAS                                                           OPT04900
 1999 FORMAT (1X,10HNAMCAS=66H,11A6,A2,1H,)                                          OPT05000
        PRINT 2008, NVHCL,(METDAT(K),K=1,3),NSND,NMODL,NPLNT                         OPT05100
 2008 FORMAT (7H NVHCL=,I1,8H ,METDAT=,3(I2,1H,),5HNSND=,I2,7H,NMODL=,I2,OPT05200
     17H,NPLNT=,I1,1H,)                                                              OPT05300
        PRINT 2000, ISKIP,NPS,NZ,NDI,NCI,NTI,ZRK,TAUK,(IZMOD(K),K=1,NNZ)             OPT05400
        PRINT 2001, JE(1),ZF,(Z(K),K=2,NZ)                                           OPT05500
        PRINT 2002,    JE(2),((GF(K,I),K=1,NNZ),I=1,3)                               OPT05600
        PRINT 2001,    JE(3),(UBAR(K),K=1,NZ)                                        OPT05700
        PRINT 2001,    JE(4),(SIGAP(K),K=1,NZ)                                       OPT05800
        PRINT 2001,    JE(5),(SIGEP(K),K=1,NZ)                                       OPT05900
        PRINT 2001,    JE(6),(SIGXO(K),K=1,NNZ)                                      OPT06000
        PRINT 2001,    JE(7),(SIGYO(K),K=1,NNZ)                                      OPT06100
        PRINT 2001,    JE(8),(SIGZO(K),K=1,NNZ)                                      OPT06200
        PRINT 2001,    JE(9),(WD(K),K=1,NZ)                                          OPT06300
        PRINT 2000, TIMAV                                                            OPT06400
        PRINT 2001,    JE(10),(DI(K),K=1,NDII)                                       OPT06500
        IF (NCII .GT. 0) PRINT 2001, JE(11),(CI(K),K=1,NCII)                         OPT06600
        IF (NTII .GT. 0) PRINT 2001, JE(14),(TI(K),K=1,NTII)                         OPT06700
        PRINT 2001, JE(12),(DX(K),K=1,NNZ)                                           OPT06800
        PRINT 2001, JE(13),(DY(K),K=1,NNZ)                                           OPT06900
        PRINT 2001, JE(15),(TV(K),K=1,NZ)                                            OPT07000
        PRINT 2011, NPTS,(ZZL(K),K=1,NPTS)                                           OPT07100
 2011 FORMAT (1X,5HNPTS=,I2,5H,ZZL=,3(F8.3,1H,))                                     OPT07200
        PRINT 2005, H                                                                OPT07300
        IF (JSWS .NE. 0) PRINT 2010, LAMBDA,TIM1,ZLIM                                OPT07400
```

```
 2010 FORMAT (1X,7HbLAMDA=,E12.6,6H,TIM1=,F9.3,6H,ZLIM=,F8.3,1H,)                OPT07500
      IF (LSW1 .GT. 0) PRINT 2012, (EXTR(K),K=1,LSW1)                           OPT07600
 2012 FORMAT (13A6,A2)                                                          OPT07700
      PRINT 2003                                                                OPT07800
 2000 FORMAT (7H ISKIP=,10(I1,1H,),4HNPS=,I2,5H,NZS=,I2,5H,NDI=,I2,5H,NCOPT07900
     1I=,I2,5H,NTI=,I2,5H,ZRK=,F5.1,1H,/6H TAUK=,F8.3,7H,IZMOD=,15(I2,1HOPT08000
     2,))                                                                       OPT08100
 2001 FORMAT (1X,A6,1H=,7(F9.3,1H,)/(1X,7(F9.3,1H,)))                          OPT08200
 2002 FORMAT (1X,A6,1H=,1P4(E14.7,1H,)/1X,5(E14.7,1H,)/(1X,5(E14.7,1H,))OPT08300
     1)                                                                         OPT08400
 2003 FORMAT (5H sEND)                                                          OPT08500
 2004 FORMAT (1X,A6,1H=,4(F11.8,1HE,3A1,1H,)/1X,4(F11.8,1HE,3A1,1H,)/           OPT08600
     11X,4(F11.8,1HE,3A1,1H,))                                                  OPT08700
 2005 FORMAT (3H H=,F9.3,1H,)                                                   OPT08800
 2006 FORMAT (7H TIMAV=,F6.1,1H,)                                               OPT08900
      IF (IOUNT .NE. 7) GO TO 30                                                OPT09000
      PUNCH 1999, NAMCAS                                                        OPT09100
      PUNCH 2006, NVMCL,(METDAT(K),K=1,3),NSND,NMODL,NPLNT                      OPT09200
      PUNCH 2000, ISKIP,NPS,NZ,NDI,NCI,NTI,ZRK,TAUK,(IZMOD(K),K=1,NNZ)          OPT09300
      PUNCH 2001, JE(1),ZF,(Z(K),K=2,NZ)                                        OPT09400
      DO 20 K=1,NNZ                                                             OPT09500
      QL(K) = QF(K,1)                                                           OPT09600
   20 CALL CONV(QL(K),IQ(K),JQ(K),KQ(K))                                        OPT09700
      PUNCH 2004, JE(2),(QL(K),KQ(K),IQ(K),JQ(K),K=1,NNZ)                       OPT09800
      PUNCH 2001, JE(3),(UBAR(K),K=1,NZ)                                        OPT09900
      PUNCH 2001, JE(4),(SIGAP(K),K=1,NZ)                                       OPT10000
      PUNCH 2001, JE(5),(SIGEP(K),K=1,NZ)                                       OPT10100
      PUNCH 2001, JE(6),(SIGXO(K),K=1,NNZ)                                      OPT10200
      PUNCH 2001, JE(7),(SIGYO(K),K=1,NNZ)                                      OPT10300
      PUNCH 2001, JE(8),(SIGZO(K),K=1,NNZ)                                      OPT10400
      PUNCH 2001, JE(9),(WD(K),K=1,NZ)                                          OPT10500
      PUNCH 2006, TIMAV                                                         OPT10600
      PUNCH 2001, JE(10),(DI(K),K=1,NDI1)                                       OPT10700
      IF (NCII .GT. 0) PUNCH 2001, JE(11),(CI(K),K=1,NCII)                      OPT10800
      IF (NTII .GT. 0) PUNCH 2001, JE(14),(TI(K),K=1,NTII)                      OPT10900
      PUNCH 2001, JE(12),(DX(K),K=1,NNZ)                                        OPT11000
      PUNCH 2001, JE(13),(DY(K),K=1,NNZ)                                        OPT11100
      PUNCH 2001, JE(15),(TV(K),K=1,NZ)                                         OPT11200
```

```
115*          PUNCH 2011, NPTS,(ZZL(K),K=1,NPTS)                                    OPT11300
116*          PUNCH 2005, H                                                         OPT11400
117*          IF (JSWS .NE. 0) PUNCH 2010, LAMBDA,TIM1,ZLIM                         OPT11500
118*          PUNCH 2007, TAUK                                                      OPT11600
119*     2007 FORMAT (1X,6HTAUOK=,F6.3,1H,)                                         OPT11700
120*          IF (LSW1 .GT. 0) PUNCH 2012, (EXTR(K),K=1,LSW1)                       OPT11800
121*          PUNCH 2003                                                            OPT11900
122*          GO TO 50                                                              OPT12000
123*       30 WRITE (IOUNT'IASV,1999) NAMCAS                                        OPT12100
124*          WRITE (IOUNT'IASV,2006) NVHCL,(METDAT(K),K=1,3),NSND,NMODL,NPLNT      OPT12200
125*          WRITE (IOUNT'IASV,2000) ISKIP,NPS,NZ,NDI,NCI,NTI,ZRK,TAUK,(IZMOD(KOPT12300
126*         1),K=1,NNZ)                                                            OPT12400
127*          WRITE (IOUNT'IASV,2001) JE(1),ZF,(Z(K),K=2,NZ)                        OPT12500
128*          DO 40 K=1,NNZ                                                         OPT12600
129*          GL(K) = QF(K,I)                                                       OPT12700
130*       40 CALL CONV(GL(K),IQ(K),JQ(K),KG(K))                                    OPT12800
131*          WRITE (IOUNT'IASV,2004) JE(2),(QL(K),KQ(K),IQ(K),JQ(K),K=1,NNZ)       OPT12900
132*          WRITE (IOUNT'IASV,2001) JE(3),(UBAR(K),K=1,NZ)                        OPT13000
133*          WRITE (IOUNT'IASV,2001) JE(4),(SIGAP(K),K=1,NZ)                       OPT13100
134*          WRITE (IOUNT'IASV,2001) JE(5),(SIGEP(K),K=1,NZ)                       OPT13200
135*          WRITE (IOUNT'IASV,2001) JE(6),(SIGXO(K),K=1,NNZ)                      OPT13300
136*          WRITE (IOUNT'IASV,2001) JE(7),(SIGYO(K),K=1,NNZ)                      OPT13400
137*          WRITE (IOUNT'IASV,2001) JE(8),(SIGZO(K),K=1,NNZ)                      OPT13500
138*          WRITE (IOUNT'IASV,2001) JE(9),(WD(K),K=1,NZ)                          OPT13600
139*          WRITE (IOUNT'IASV,2006) TIMAV                                         OPT13700
140*          WRITE (IOUNT'IASV,2001) JE(10),(DI(K),K=1,NDII)                       OPT13800
141*          IF (NCII .GT. 0) WRITE (IOUNT'IASV,2001) JE(11),(CI(K),K=1,NCII)      OPT13900
142*          IF (NTII .GT. 0) WRITE (IOUNT'IASV,2001) JE(14),(TI(K),K=1,NTII)      OPT14000
143*          WRITE (IOUNT'IASV,2001) JE(12),(DX(K),K=1,NNZ)                        OPT14100
144*          WRITE (IOUNT'IASV,2001) JE(13),(DY(K),K=1,NNZ)                        OPT14200
145*          WRITE (IOUNT'IASV,2001) JE(15),(TV(K),K=1,NZ)                         OPT14300
146*          WRITE (IOUNT'IASV,2011) NPTS,(ZZL(K),K=1,NPTS)                        OPT14400
147*          WRITE (IOUNT'IASV,2005) H                                             OPT14500
148*          IF (JSWS .NE. 0) WRITE (IOUNT'IASV,2010) LAMBDA,TIM1,ZLIM             OPT14600
149*          WRITE (IOUNT'IASV,2007) TAUK                                          OPT14700
150*          IF (LSW1 .GT. 0) WRITE (IOUNT'IASV,2012) (EXTR(K),K=1,LSW1)           OPT14800
151*          WRITE (IOUNT'IASV,2003)                                               OPT14900
152*          IEND = IASV-1                                                         OPT15000
```


43

```
      WRITE (12,2009) NVHCL,(METDAT(K),K=1,3),NSND,NMODL,NPLNT,ISTRT,    OPT15100
     1IEND                                                               OPT15200
2009 FORMAT (I3,3I2,I2,I3,I1,2I6)                                        OPT15300
  50 CONTINUE                                                            OPT15400
      NZ = NZM                                                           OPT15500
      RETURN                                                             OPT15600
      END                                                                OPT15700
```

```
      SUBROUTINE TURB, VERSION 6,  REVISION 0

      SUBROUTINE TURB                                                    TRB00100
      COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),TRB00200
     1P(21),Z(21),UBAR(21),NZS,G(20),QT,HM,SIGEP(21),SIGAP(21),G,TAUK,  TRB00300
     2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                    TRB00400
      COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS           TRB00500
      PHI1 = G*DPDZ/T(1)                                                 TRB00600
      TAUK = PI/SQRT(PHI1)                                               TRB00700
      IF (TAUK .GT. 600.0) TAUK = 600.0                                  TRB00800
      K = 0                                                              TRB00900
   10 K = K+1                                                            TRB01000
      IF (K .GT. NZS) GO TO 40                                           TRB01100
      IF (Z(K) .GT. HM) GO TO 35                                         TRB01200
      SIGAP(K) = SIGAP(1)                                                TRB01300
      SIGEP(K) = SIGAP(1)                                                TRB01400
      GO TO 10                                                           TRB01500
   35 SIGAP(K) = 1.0                                                     TRB01600
      SIGEP(K) = 1.0                                                     TRB01700
      GO TO 10                                                           TRB01800
   40 CONTINUE                                                           TRB01900
      RETURN                                                             TRB02000
      END                                                                TRB02100
```

```
      SUBROUTINE DELTXY, VERSION  6, REVISION 0

      SUBROUTINE DELTXY                                                      DXY00100
      COMMON /PLUME/ GC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),DXY00200
     1P(21),Z(21),UBAR(21),NZS,G(20),GT,HM,SIGEP(21),SIGAP(21),G,TAUK,  DXY00300
     2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                     DXY00400
      COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS            DXY00500
      COMMON /OUT/ GF(20,4),HD(21),ISKIP(10),NYS,NDI,NCI,NBK,NPTS,ZRK,   DXY00600
     1JBOT,JTOP,IZMOD,CI(10),DI(10),ZZL(2)                               DXY00700
      COMMON/DISPL/ DXX,DX(21),DYY,DY(21),ILXY,TIMC(21)                  DXY00800
      IP = 4                                                             DXY00900
      XL = GAMMAZ                                                        DXY01000
      IF (NORMAL .EQ. 1) GO TO 5                                         DXY01100
      IP = 3                                                             DXY01200
      XL = 1.0                                                           DXY01300
    5 UF = 0.0                                                           DXY01400
      ZF = 0.0                                                           DXY01500
      A1 = RHO*CP*PI*GAMMAX*GAMMAY*XL/(3.0*GC*HEAT)                      DXY01600
      IF (NORMAL .EQ. 1) A1 = A1/A                                       DXY01700
      B1 = G/T(1)                                                        DXY01800
      S = 1.0/SQRT(G*DPDZ/T(1))                                          DXY01900
      PPI = PI*5.5555555E-3                                              DXY02000
      TSTP = PI*S                                                        DXY02100
      PPIA = 1.0/PPI                                                     DXY02200
      DXX = 0.0                                                          DXY02300
      DYY = 0.0                                                          DXY02400
      I = 0                                                              DXY02500
      TI = 0.0                                                           DXY02600
   10 I = I+1                                                            DXY02700
      IF (I .GE. NZS) GO TO 30                                           DXY02800
      CALL LEAST(Z,TV,DPDZS,I+1,0,0.0,0.0,0.0)                           DXY02900
      IF (DPDZS .LT. 3.322E-4) DPDZS = 3.322E-4                          DXY03000
      BK = A1*DPDZS                                                      DXY03100
      IF (NORMAL .EQ. 0) GO TO 12                                        DXY03200
      BK = BK/(Z(I+1)**B+C/A)                                            DXY03300
      GO TO 15                                                           DXY03400
   12 CONTINUE                                                           DXY03500
      UFS= UF+(Z(I+1)-Z(I))*.5*(UBAR(I+1)+UBAR(I))                       DXY03600
```

```
      ZFS= ZF+(Z(I+1)-Z(I))                                                    DXY03700
      BK = BK*UFS/ZFS                                                          DXY03800
   15 CONTINUE                                                                 DXY03900
      ZD = BK*Z(I+1)**IP                                                       DXY04000
      IF (ZD .GT. 2.0) GO TO 20                                                DXY04100
      THETAK = (WD(I+1)+WD(I))*0.5                                             DXY04200
      IF (ABS(WD(I+1)-WD(I)) .GT. 180.0) THETAK = THETAK-180.0                 DXY04300
      BD = 1.0-ZD                                                              DXY04400
      IF (BD .GT. 1.0) BD = 1.0                                                DXY04500
      IF (BD .LT.-1.0) BD = -1.0                                               DXY04600
      S = 1.0/SQRT(B1*DPDZS)                                                   DXY04700
      TK = S*ARCOS(BD)-TT                                                      DXY04800
      TT = TK+TT                                                               DXY04900
      IF (TT .LE. TSTR) GO TO 17                                               DXY05000
      TT = TT-TK                                                               DXY05100
      GO TO 20                                                                 DXY05200
   17 CONTINUE                                                                 DXY05300
      UF = UFS                                                                 DXY05400
      ZF = ZFS                                                                 DXY05500
      IF (NORMAL .EQ. 0) GO TO 18                                              DXY05600
      RK = 0.5*(UBAR(I+1)+UBAR(I))*TK                                          DXY05700
      GO TO 19                                                                 DXY05800
   18 RK = UF*TK/ZF                                                            DXY05900
   19 CONTINUE                                                                 DXY06000
      BB = THETAK*PPI                                                          DXY06100
      DY(I) = DY(I-1)-RK*COS(BB)                                               DXY06200
      DX(I) = DX(I-1)-RK*SIN(BB)                                               DXY06300
      TIME(I) = TT                                                             DXY06400
      ILAY = I                                                                 DXY06500
      GO TO 10                                                                 DXY06600
   20 RK = ((ZM-Z(I))/(Z(I+1)-Z(I))*0.5*(UBAR(I+1)-UBAR(I))+UBAR(I))           DXY06700
      IF (NORMAL .EQ. 1) GO TO 25                                              DXY06800
      RK = RK*(ZM-Z(I))+UF                                                     DXY06900
      ZF = ZF+(ZM-Z(I))                                                        DXY07000
      RK = RK/ZF                                                               DXY07100
   25 RK = RK*(TSTR-TT)                                                        DXY07200
      BD = WD(I+1)-WD(I)                                                       DXY07300
      IF (BD .GT. 180.0) BD = BD-360.0                                         DXY07400
```


47

```
      IF (BB .LT. -180.0) BB = BB+360.0                                    DXY07500
      BB = AMOD(BB,360.0)                                                  DXY07600
      THETAM = BB/(Z(I+1)-Z(I))*(ZM-Z(I))+WD(I)                            DXY07700
      THETAK = 0.5*(THETAM+WD(I))                                          DXY07800
      IF (ABS(THETAM-WD(I)) .GT. 180.0) THETAK = THETAK-180.0              DXY07900
      BB = THETAK*PPI                                                      DXY08000
      DX(I) = DX(I-1)-RK*SIN(BB)                                           DXY08100
      DY(I) = DY(I-1)-RK*COS(BB)                                           DXY08200
      TIMC(I) = TSTR                                                       DXY08300
      ILXY = I                                                             DXY08400
   28 I = I+1                                                              DXY08500
      IF (I .GE. NZS) GO TO 30                                             DXY08600
      RK = TSTR*0.5*(UBAR(I+1)+UBAR(I))                                    DXY08700
      ZF = 0.5*(WD(I+1)+WD(I))                                             DXY08800
      IF (ABS(WD(I+1)-WD(I)) .GT. 180.0) ZF = ZF-180.0                     DXY08900
      BB = ZF*PPI                                                          DXY09000
      DX(I) = -RK*SIN(BB)                                                  DXY09100
      DY(I) = -RK*COS(BB)                                                  DXY09200
      TIMC(I) = TSTR                                                       DXY09300
      GO TO 28                                                             DXY09400
   30 CONTINUE                                                             DXY09500
      I = NZS-1                                                            DXY09600
      DO 80 J =1,I                                                         DXY09700
      IF (DX(J)) 50,40,50                                                  DXY09800
   40 IF (DY(J)) 50,80,50                                                  DXY09900
   50 BB = 270.0-ATAN2(DY(J),DX(J))*PPI                                    DXY10000
      IF (BB .GT. 360.0) BB = BB-360.0                                     DXY10100
      IF (BB .GT. 180.0) GO TO 60                                          DXY10200
      BB = BB+180.0                                                        DXY10300
      GO TO 70                                                             DXY10400
   60 BB = BB-180.0                                                        DXY10500
   70 DX(J) = SQRT(DX(J)*DX(J)+DY(J)*DY(J))+0.5*(UBAR(J+1)+UBAR(J))*       DXY10600
     1(ISTR-TIMC(J))                                                       DXY10700
      DY(J) = BB                                                           DXY10800
   80 CONTINUE                                                             DXY10900
      RETURN                                                               DXY11000
      END                                                                  DXY11100
```

```
1*            SUBROUTINE DIST4, VERSION 5, REVISION 0
2*
3*            SUBROUTINE DIST4(ISW8)                                                DS400100
4*            COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),DS400200
5*           1P(21),Z(21),UBAR(21),NZS,Q(20),QT,HM,SIGEP(21),SIGAP(21),G,TAUK,  DS400300
6*           2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                     DS400400
7*            COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS             DS400500
8*            DOUBLE PRECISION D0,D1,D2,D3,D4,D5,D6                               DS400600
9*            DATA D1,D2,D3,D4,D5,D6/4.9867347D-2,2.11410061D-2,3.2776263D-3,     DS400700
10*           13.80036D-3,4.88906D-5,5.383D-6/                                    DS400800
11*           IF (NORMAL .EQ. 0) GO TO 5                                          DS400900
12*           QG = QC*(A*ZM**B+C)                                                 DS401000
13*           GO TO 6                                                             DS401100
14*         5 QG = QT                                                             DS401200
15*         6 IF (ISW8 .EQ. 1) GO TO 8                                            DS401300
16*           SQ2I = 1.0/(GAMMAZ*ZM*.465116279)                                   DS401400
17*           PHI = 0.0                                                           DS401500
18*           GO TO 9                                                             DS401600
19*         8 SQ2I = 0.75/(GAMMAZ*ZM)                                             DS401700
20*           PHI = 1.0/(3.0*(GAMMAZ*ZM)**2)                                      DS401800
21*           ZIC = ZM*(1.0+GAMMAZ)                                               DS401900
22*           ZDC = ZM*(1.0-GAMMAZ)                                               DS402000
23*         9 K = 1                                                               DS402100
24*        10 K = K+1                                                             DS402200
25*           IF (ISW8 .EQ. 1) GO TO 61                                           DS402300
26*           IFLG = 0                                                            DS402400
27*           ZP = (Z(K)-ZM)*SQ2I                                                 DS402500
28*           IF (ZP) 20,15,30                                                    DS402600
29*        15 CONTINUE                                                            DS402700
30*           PZ = 0.5                                                            DS402800
31*           GO TO 60                                                            DS402900
32*        20 CONTINUE                                                            DS403000
33*           ZP = -ZP                                                            DS403100
34*           IFLG = 1                                                            DS403200
35*        30 D0 = 1.0-0.5*(1.0+ZP*(D1+ZP*(D2+ZP*(D3+ZP*(D4+ZP*(D5+ZP*D6))))))**DS403300
36*          1(-16)                                                               DS403400
37*           PZ = D0                                                             DS403500
38*           IF (IFLG .EQ. 1) PZ = 1.0-PZ                                        DS403600
```

```
59*          60 PZP = PZ-PHI                                                    DS403700
60*             GO TO 62                                                        DS403800
61*          61 PZP = 0.0                                                       DS403900
62*             ZT = Z(K)                                                       DS404000
63*             ZB = Z(K-1)                                                     DS404100
64*             IF (ZB .GT. ZTC.OR.ZT .LT. ZBC) GO TO 62                        DS404200
65*             IF (ZT .GT. ZTC) ZT = ZTC                                       DS404300
66*             IF (ZB .LT. ZBC) ZB = ZBC                                       DS404400
67*             PZP = SQ2I*((ZT-ZB)-((ZT-ZM)**3-(ZB-ZM)**3)*PHI)                DS404500
68*          62 Q(K-1) = PZP*QQ                                                 DS404600
69*             IF (Q(K-1) .LT. 0.0) Q(K-1) = 0.0                               DS404700
70*             IF (ISWB .EQ. 0.AND.Q(K-1) .LT. 1.0E-20) QQ = 0.0               DS404800
71*             IF (ISWB .EQ. 0) PHI = PZ                                       DS404900
72*             IF (K .LT. NZS) GO TO 10                                        DS405000
73*             IF (NORMAL .EQ. 0) GO TO 90                                     DS405100
74*             K = 2                                                           DS405200
75*             ZP = ZM                                                         DS405300
76*          70 IF (Z(K) .GE. ZM) GO TO 80                                      DS405400
77*             K = K+1                                                         DS405500
78*             IF (K .LE. NZS) GO TO 70                                        DS405600
79*             GO TO 90                                                        DS405700
80*          80 IF (K .GT. NZS) GO TO 90                                        DS405800
81*             Q(K-1) = QC*A*(Z(K)**B-ZP**B)+Q(K-1)                            DS405900
82*             ZP = Z(K)                                                       DS406000
83*             K = K+1                                                         DS406100
84*             GO TO 80                                                        DS406200
85*          90 CONTINUE                                                        DS406300
86*             RETURN                                                          DS406400
87*             END                                                             DS406500
```

```
      SUBROUTINE DIST3, VERSION 5, REVISION 0
C
      SUBROUTINE DIST3(ISW8)                                                DS300100
      COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),DS300200
     1P(21),Z(21),UBAR(21),NZS,G(20),QT,HM,SIGEP(21),SIGAP(21),G,TAUK,  DS300300
     2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                    DS300400
      COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS           DS300500
      DOUBLE PRECISION D0,D1,D2,D3,D4,D5,D6                             DS300600
      DATA D1,D2,D3,D4,D5,D6/4.9867347D-2,2.11410061D-2,3.2776263D-3,    DS300700
     13.80036D-5,4.888960-5,5.383D-6/                                   DS300800
      IF (NORMAL .EQ. 0) GO TO 2                                        DS300900
      QQ = QC*(A*ZM**B+C)                                               DS301000
      GO TO 3                                                           DS301100
    2 QQ = QT                                                           DS301200
    3 CONTINUE                                                          DS301300
      IF (ISW8 .NE. 1) GO TO 4                                          DS301400
      ZTC = ZM*(1.0+GAMMAZ)                                             DS301500
      ZBC = ZM*(1.0-GAMMAZ)                                             DS301600
      GO TO 35                                                          DS301700
    4 CONTINUE                                                          DS301800
      IFLG = 0                                                          DS301900
      ZP = (HM-ZM)/(GAMMAZ*ZM*.465116279)                               DS302000
      PZ = 0.5                                                          DS302100
      IF (ZP) 5,40,10                                                   DS302200
    5 CONTINUE                                                          DS302300
      ZP = -ZP                                                          DS302400
      IFLG = 1                                                          DS302500
   10 D0 = 1.0-0.5*(1.0+ZP*(D1+ZP*(D2+ZP*(D3+ZP*(D4+ZP*(D5+ZP*D6))))))**DS302600
     1(-16)                                                             DS302700
      PZ = D0                                                           DS302800
      IF (IFLG .EQ. 1) PZ = 1.0-PZ                                      DS302900
      GO TO 40                                                          DS303000
   35 PZ = 0.0                                                          DS303100
      ZT = HM                                                           DS303200
      ZB = Z(1)                                                         DS303300
      IF (ZT .GT. ZBC) GO TO 36                                         DS303400
      PRINT 1000                                                        DS303500
 1000 FORMAT (38H0*** WARNING CLOUD IS TOTALLY ABOVE HM/)               DS303600
```


51

```
39*          GO TO 40                                                                    DS303700
40*        36 IF (ZB .LT. ZTC) GO TO 37                                                  DS303800
41*           PRINT 1001                                                                 DS303900
42*      1001 FORMAT (56H0*** WARNING CLOUD IS TOTALLY BELOW LOWER LAYER BOUNDARDS304000
43*          1Y/)                                                                       DS304100
44*           GO TO 40                                                                  DS304200
45*        37 IF (ZT .GT. ZTC) ZT = ZTC                                                 DS304300
46*           IF (ZB .LT. ZBC) ZB = ZBC                                                 DS304400
47*           PZ = 0.75/(GAMMAZ*ZM)*((ZT-ZB)-((ZT-ZM)**3-(ZB-ZM)**3)*1.0/(3.0*          DS304500
48*          1(GAMMAZ*ZM)**2))                                                          DS304600
49*        40 Q(1) = PZ*QQ                                                              DS304700
50*           RETURN                                                                    DS304800
51*           END                                                                       DS304900
```

```
      SUBROUTINE CONV, VERSION 5, REVISION 0
C
      SUBROUTINE CONV(Q,I,J,K)                                          CNV00100
      DIMENSION ICHAR(12)                                               CNV00200
      DATA ICHAR/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H+,1H-/       CNV00300
      R = 0.0                                                           CNV00400
      IP = 0                                                            CNV00500
      K = ICHAR(11)                                                     CNV00600
      IF (Q) 100,55,10                                                  CNV00700
   10 IF (Q-1.0) 20,30,40                                               CNV00800
   20 IP = 0                                                            CNV00900
      R = Q                                                             CNV01000
   21 IF (R .GT. 1.0) GO TO 50                                          CNV01100
      IP = IP-1                                                         CNV01200
      R = R*10.0                                                        CNV01300
      GO TO 21                                                          CNV01400
   30 R = Q                                                             CNV01500
      IP = 0                                                            CNV01600
      GO TO 55                                                          CNV01700
   40 IP = 0                                                            CNV01800
      R = Q                                                             CNV01900
   41 IF (R .LT. 10.0) GO TO 50                                         CNV02000
      IP = IP+1                                                         CNV02100
      R = R*0.1                                                         CNV02200
      GO TO 41                                                          CNV02300
   50 CONTINUE                                                          CNV02400
      Q = R                                                             CNV02500
      K = ICHAR(11)                                                     CNV02600
      IF (IP .LT. 0) K = ICHAR(12)                                      CNV02700
   55 I = IABS(IP/10)                                                   CNV02800
      J = IABS(IP)-I*10                                                 CNV02900
   60 DO 70 L=1,10                                                      CNV03000
      IF (I .NE. L-1) GO TO 70                                          CNV03100
      I = ICHAR(L)                                                      CNV03200
      GO TO 71                                                          CNV03300
   70 CONTINUE                                                          CNV03400
      GO TO 110                                                         CNV03500
   71 CONTINUE                                                          CNV03600
```

TABLE OF CONTENTS

Section		Title	Page No.	
		INTRODUCTION	1	1/A4
A		USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM—VERSION 6	3	1/A6
	A.1	Program Input Parameters	3	1/A6
	A.2	Program Input Data Card Sequence	4	1/A7
	A.3	Preprocessor Program Output	12	1/B1
	A.4	Fortran Source Listing for the NASA/MSFC Cloud-Rise Preprocessor Program —Version 6	12	1/B1
B		USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM — VERSION 6	65	2/B11
	B.1	Program Description	65	2/B11
	B.2	Program Input Parameters	66	2/B12
	B.3	Condensed Table of Namelist Input Parameters	90	2/D8
	B.4	Data Input Format	98	2/E9
	B.5	Fortran Source Listing for the NASA/MSFC Multilayer Diffusion Program — Version 6	99	2/E10

```
      DO 80 L=1,10                                                                  CNV03700
      IF (J .NE. L-1) GO TO 80                                                      CNV03800
      J = ICHAR(L)                                                                  CNV03900
      GO TO 81                                                                      CNV04000
   80 CONTINUE                                                                      CNV04100
      GO TO 110                                                                     CNV04200
   81 CONTINUE                                                                      CNV04300
   90 RETURN                                                                        CNV04400
  100 PRINT 2000, Q                                                                 CNV04500
      GO TO 90                                                                      CNV04600
  110 PRINT 2001, Q                                                                 CNV04700
      GO TO 90                                                                      CNV04800
 2000 FORMAT (39H *--*ERROR*--* SOURCE STRENGTH NEGATIVE =,E15.8)                   CNV04900
 2001 FORMAT (47H *--*ERROR*--* POWER OF 10 ON Q TOO MANY DIGITS =,E15.8)           CNV05000
      END                                                                           CNV05100
```

```
1*            SUBROUTINE DIM34, VERSION 5, REVISION 0
2*
3*            SUBROUTINE DIM34                                                    D3400100
4*            COMMON /PLUME/ GC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),D3400200
5*           1P(21),Z(21),UBAR(21),NZS,G(20),QT,HM,SIGEP(21),SIGAP(21),C,TAUK,  D3400300
6*           2NORMAL,TV(21),RM(21),NAMCAS(12),NAMT(12),SIGAR                     D3400400
7*            COMMON /SIG/ SIGX0(20),SIGY0(20),SIGZ0(20),H                       D3400500
8*            COMMON /RESI/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS            D3400600
9*            IF(IFLG .EQ. 1) GO TO 30                                           D3400700
10*     C      SOURCE DIMENSIONS FOR MODEL 3                                      D3400800
11*           IF (ZM .LT. HM-GAMMAZ*ZM) GO TO 10                                  D3400900
12*           SIGZ0(1) = (HM-ZM+GAMMAZ*ZM)*.2325581                               D3401000
13*           H = (HM+ZM-GAMMAZ*ZM)*0.5                                           D3401100
14*           GO TO 20                                                            D3401200
15*        10 SIGZ0(1) = GAMMAZ*ZM*.465116279                                     D3401300
16*           H = ZM                                                              D3401400
17*        20 SIGA0(1) = GAMMAX*ZM*.465116279                                     D3401500
18*           SIGY0(1) = GAMMAY*ZM*.465116279                                     D3401600
19*           IF (SIGZ0(1) .GT. 0.0) GO TO 50                                     D3401700
20*           H = 0.5*(HM-Z(1))                                                   D3401800
21*           SIGZ0(1) = GAMMAZ*H*.465116279                                      D3401900
22*           GO TO 50                                                            D3402000
23*     C      SOURCE DIMENSIONS FOR MODEL 4                                      D3402100
24*        30 DO 40 K=2,NZS                                                       D3402200
25*           ZM = Z(K-1)                                                         D3402300
26*           IF (K .EQ. 2) ZM = 0.0                                              D3402400
27*           ZP = 0.5*(Z(K)-ZM)+ZM                                               D3402500
28*           IF (ZP .GT. ZM) GO TO 35                                            D3402600
29*           SA0 = ZM                                                            D3402700
30*           GO TO 36                                                            D3402800
31*        35 SA0 = (2.0*ZM-ZP)                                                   D3402900
32*        36 SY0 = SX0*GAMMAY*.465116279                                         D3403000
33*           SA0 = SX0*GAMMAX*.465116279                                         D3403100
34*           IF (SY0 .LT. 0.0) SY0 = 0.0                                         D3403200
35*           IF (SX0 .LT. 0.0) SA0 = 0.0                                         D3403300
36*           IF (NORMAL .EQ. 0) GO TO 38                                         D3403400
37*           IF (ZP .LE. ZM) GO TO 38                                            D3403500
38*           IF (SX0 .LT. 93.0) SX0 = 93.0                                       D3403600
```

```
      IF (SYO .LT. 93.0) SYO = 93.0                                    D3403700
   38 SAGXO(K-1) = SXO                                                 D3403800
      SAGYO(K-1) = SYO                                                 D3403900
      SAGZO(K-1) = 0.0                                                 D3404000
   40 CONTINUE                                                         D3404100
      M = 2M                                                           D3404200
   50 RETURN                                                           D3404300
      END                                                              D3404400
```

```
1.          SUBROUTINE TPZ, VERSION 5, REVISION 0
2.
3.          FUNCTION TPZ(A,B,C,D,E)                                    TPZ00100
4.          TPZ = (A-B)*(C-D)/(A-E)                                    TPZ00200
5.          RETURN                                                     TPZ00300
6.          END                                                        TPZ00400
```

```
      SUBROUTINE CPHI, VERSION 5, REVISION 0
C
      FUNCTION CPHI(A,B)                                          PHI00100
      CPHI = A*(1000.0/B)**0.266                                  PHI00200
      RETURN                                                      PHI00300
      END                                                         PHI00400
```

```
      SUBROUTINE PLUME1, VERSION 5, REVISION 0

      SUBROUTINE PLUME1                                                      PL100100
      COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),PL100200
     1P(21),Z(21),UBAR(21),NZS,G(20),QT,HM,SIGEP(21),SIGAP(21),G,TAUK,  PL100300
     2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                     PL100400
      COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS             PL100500
C     PLUME RISE FOR INSTANTANEOUS SOURCE                                 PL100600
      A1 = 6.0*QC*A*HEAT/(RHO*CP*PI*GAMMAX*GAMMAY*GAMMAZ)                 PL100700
      B1 = 1.0/(4.0-B)                                                    PL100800
      K = 1                                                               PL100900
   10 K = K+1                                                             PL101000
   20 CALL LEAST(2,TV,DPDZ,K,0,0.0,0.0,0.0)                               PL101100
      IF (DPDZ .LT. 3.322E-4) DPDZ = 3.322E-4                             PL101200
      ZM = (A1/DPDZ)**B1                                                  PL101300
      ZM = (A1/A*(A*ZM**B+C)/DPDZ)**0.25                                  PL101400
      IF (ZM .LE. Z(K)) GO TO 30                                          PL101500
      K = K+1                                                             PL101600
      IF (K .GT. NZS) GO TO 80                                            PL101700
      GO TO 20                                                            PL101800
   30 IF (Z(K)-ZM .LE. 10.0) GO TO 70                                     PL101900
      IF (DPDZ-3.322E-4) 35,70,35                                         PL102000
   35 CONTINUE                                                            PL102100
      ZP = Z(K)                                                           PL102200
   40 ZP = ZP-10.0                                                        PL102300
      IF (ZP .LT. Z(1)) GO TO 85                                          PL102400
      TVP = TV(K)-TPZ(Z(K),ZP,TV(K),TV(K-1),Z(K-1))                       PL102500
      CALL LEAST(2,TV,DPDZ,K-1,1,ZP,TVP)                                  PL102600
      IF (DPDZ .GT. 3.322E-4) GO TO 60                                    PL102700
      DPDZ = 3.322E-4                                                     PL102800
   50 ZM = ZP                                                             PL102900
      GO TO 70                                                            PL103000
   60 ZM = (A1/DPDZ)**B1                                                  PL103100
      ZM = (A1/A*(A*ZM**B+C)/DPDZ)**0.25                                  PL103200
      IF (ZM .GT. ZP) GO TO 50                                            PL103300
      IF (ZM .GT. ZP-10.0) GO TO 70                                       PL103400
      IF (ZP .GE. Z(K-1)) GO TO 40                                        PL103500
      ZM = Z(K-1)                                                         PL103600
```

```
C     RETURN ZM AND DPDZ FOR INSTANTANEOUS SOURCE                    PL103700
   70 IFLG = 0                                                       PL103800
      GO TO 90                                                       PL103900
C     CANNOT CALCULATE ZM AND DPDZ                                   PL104000
   80 IFLG = 1                                                       PL104100
      GO TO 90                                                       PL104200
   85 IFLG = 2                                                       PL104300
   90 RETURN                                                         PL104400
      END                                                            PL104500
```

```
      SUBROUTINE PLUME2, VERSION 5, REVISION 0

      SUBROUTINE PLUME2                                                  PL200100
      COMMON /PLUME/ QC,A,B,C,HEAT,RHO,CP,PI,GAMMAX,GAMMAY,GAMMAZ,T(21),PL200200
     1P(21),Z(21),UBAR(21),NZS,Q(20),QT,HA,SIGEP(21),SIGAP(21),G,TAUK,  PL200300
     2NORMAL,TV(21),RH(21),NAMCAS(12),NAMT(12),SIGAR                    PL200400
      COMMON /REST/ ZM,DPDZ,K,A1,B1,PHI1,ZP,TZ,PZ,PHI,IFLG,KS           PL200500
C     PLUME RISE FOR CONTINUOUS SOURCE                                   PL200600
      ZSUM = 0.0                                                         PL200700
      UBARS = 0.0                                                        PL200800
      A1 = 6.0*QC*HEAT/(RHO*CP*PI*GAMMAX*GAMMAY)                         PL200900
      B1 = .3333333                                                      PL201000
      K = 1                                                              PL201100
   10 K = K+1                                                            PL201200
   20 CALL LEAST(Z,TV,DPDZ,K,0,0.0,0.0)                                  PL201300
      IF (DPDZ .LT. 3.322E-4) DPDZ = 3.322E-4                            PL201400
      UBARS = UBARS+(Z(K)-Z(K-1))*(UBAR(K)+UBAR(K-1))*0.5                PL201500
      ZSUM = ZSUM+Z(K)-Z(K-1)                                            PL201600
      UBARK = UBARS/ZSUM                                                 PL201700
      ZM = (A1/(UBARK*DPDZ))**B1                                         PL201800
      IF (ZM .LE. Z(K)) GO TO 30                                         PL201900
      K = K+1                                                            PL202000
      IF (K .GT. NZS) GO TO 60                                           PL202100
      GO TO 20                                                           PL202200
   30 IF (Z(K)-ZM .LE. 10.0) GO TO 70                                    PL202300
      IF (DPDZ-3.322E-4) 35,70,35                                        PL202400
   35 CONTINUE                                                           PL202500
      UBARK = UBARS-(Z(K)-Z(K-1))*(UBAR(K)+UBAR(K-1))*0.5                PL202600
      ZBARK = ZSUM-(Z(K)-Z(K-1))                                         PL202700
      ZP = Z(K)                                                          PL202800
   40 ZP = ZP-10.0                                                       PL202900
      IF (ZP .LT. Z(1)) GO TO 85                                         PL203000
      TVP = TV(K)-TPZ(Z(K),ZP,TV(K),TV(K-1),Z(K-1))                      PL203100
      CALL LEAST(Z,TV,DPDZ,K-1,1,ZP,TVP)                                 PL203200
      IF (DPDZ .GT. 3.322E-4) GO TO 60                                   PL203300
      DPDZ = 3.322E-4                                                    PL203400
   50 ZM = ZP                                                            PL203500
      GO TO 70                                                           PL203600
```

```
      60 UBARZ = UBAR(K)-TPZ(Z(K),ZP,UBAR(K),UBAR(K-1),Z(K-1))                  PL203700
         UBARZ = (UBARK+(ZP-Z(K-1))*(UBARZ+UBAR(K-1))*0.5)/(ZBARK+ZP-Z(K-1))PL203800
        1)                                                                     PL203900
         ZM = (A1/(UBARZ*DPDZ))**B1                                            PL204000
         IF (ZM .GT. ZP) GO TO 50                                              PL204100
         IF (ZM .GT. ZP-10.0) GO TO 70                                         PL204200
         IF (ZP .GE. Z(K-1)) GO TO 40                                          PL204300
         ZM = Z(K-1)                                                           PL204400
C        RETURN ZM AND DPDZ FOR CONTINUOUS SOURCE                              PL204500
      70 IFLG = 0                                                              PL204600
         GO TO 90                                                              PL204700
C        CANNOT CALCULATE ZM AND DPDZ                                          PL204800
      80 IFLG = 1                                                              PL204900
         GO TO 90                                                              PL205000
      85 IFLG = 2                                                              PL205100
      90 RETURN                                                                PL205200
         END                                                                   PL205300
```

```
1.          SUBROUTINE ARCOS, VERSION 5, REVISION 0
2.
3.          FUNCTION ARCOS(A)                                          ACS00100
4.          ARCOS = ACOS(A)                                            ACS00200
5.          RETURN                                                     ACS00300
6.          END                                                        ACS00400
```

```
      SUBROUTINE LEAST, VERSION 5, REVISION 0
C
      SUBROUTINE LEAST(Z,TV,DPDZ,K,ISW,ZP,TVP)                    LST00100
      DIMENSION Z(1),TV(1)                                        LST00200
      IF (K .LE. 1) GO TO 30                                      LST00300
      L = K                                                       LST00400
      TVB = 0.0                                                   LST00500
      ZB = 0.0                                                    LST00600
      DO 10 I=1,K                                                 LST00700
      TVB = TVB+TV(I)                                             LST00800
   10 ZB = ZB+Z(I)                                                LST00900
      IF (ISW .EQ. 0) GO TO 15                                    LST01000
      TVB = TVB+TVP                                               LST01100
      ZB = ZB+ZP                                                  LST01200
      L = L+1                                                     LST01300
   15 TVB = TVB/FLOAT(L)                                          LST01400
      ZB = ZB/FLOAT(L)                                            LST01500
      S1 = 0.0                                                    LST01600
      S2 = 0.0                                                    LST01700
      DO 20 I=1,K                                                 LST01800
      S1 = S1+(Z(I)-ZB)*(TV(I)-TVB)                               LST01900
   20 S2 = S2+(Z(I)-ZB)**2                                        LST02000
      IF (ISW .EQ. 0) GO TO 25                                    LST02100
      S1 = S1+(ZP-ZB)*(TVP-TVB)                                   LST02200
      S2 = S2+(ZP-ZB)**2                                          LST02300
   25 DPDZ = S1/S2                                                LST02400
   30 CONTINUE                                                    LST02500
      RETURN                                                      LST02600
      END                                                         LST02700
```

SECTION B

USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM—VERSION 6

B.1 PROGRAM DESCRIPTION

The NASA/MSFC Multilayer Diffusion Program— Version 6 is designed to calculate patterns of:

- Concentration
- Dosage
- Time-mean concentration
- Average cloud concentration
- Time of cloud passage
- Ground-level deposition due to precipitation scavenging
- Ground-level deposition due to gravitational settling

Program options include the calculation of concentration, dosage and time-mean concentration with partial reflection, with time dependent decay, and/or with depletion due to precipitation scavenging. Also, the Program is capable of calculating ground-level gravitational deposition with partial reflection of material at the surface. Other program options include the printing of all data inputs, the printing of all model calculations, the plotting of concentration, dosage and/or time-mean concentration on the printer page, and the plotting of concentration, dosage and/or time-mean concentration on the SC4020 plotter at Marshall Space Flight Center. The program can be operated alone or with the Cloud-Rise Preprocessor Program described in Section A.

The NASA/MSFC Multilayer Diffusion Computer Program — Version 6 is written in FORTRAN IV and is designed for use on the Univac 1108 computer at Marshall Space Flight Center, Huntsville, Alabama. The program requires 36,000 locations of core storage on the Univac 1108 computer. The FORTRAN source listing is shown in Section B.5, and a complete list of program input parameters and program options is given in Section B.2 and B.3. The program also requires mass storage units 9, 11 and 13 for use as scratch files. It is the users' responsibility to assign these files, and they can be assigned the Univac 1108 default file size. Also, the user may optionally use mass storage file 10 and mass storage or tape file 12. If used, these files were created by the Cloud-Rise Preprocessor Program given in Section A. The assigning and managing of these files is, again, the users' responsibility. Files 10 and 12 are discussed further under NVHCLC and INUNT on data input card 1 in Section B.2.

B.2 PROGRAM INPUT PARAMETERS

Each program input data deck consists of a case identification card followed by a namelist data deck, where the namelist name is $NAM2. These data can be in punched card form or can be on mass storage and/or magnetic tape from the Preprocessor Program. The first data card of each case contains:

Column 1 (NVHCLC) - Integer representing the vehicle for which the run is to be made

- 1 = Titan IIIC
- 2 = Space Shuttle
- 3 = Delta-Thor 2914
- 4 = Minuteman II
- 5 = Delta-Thor 3914

Special Note - If Column 1 (NVHCLC) is input as zero or blank, the Program assumes that multiple cases have been stacked on mass storage unit 10 and magnetic tape or mass storage unit 12 by the Preprocessor Program. This Main Program will then execute all of the cases sequentially and automatically without any additional input. All variables on this one input card must be blank or zero

Column 2-7 (METDTC)	-	Six digit integer giving the month, day and year of the meteorological data. Punch as MMDDYYR.
Column 8-9 (NSNDC)	-	Hour of the meteorological sounding, right justified (00-24).
Column 10-12 (NMODLC)	-	Model number (right justified). If mass storage Preprocessor Program data is being used, make sure this data item and all others on this card are punched in the same way the Preprocessor has output and printed them.
Column 13 (NPLNTC)	-	Number representing the pollutant. 1 = HCl 2 = CO 3 = CO_2 4 = Al_2O_3
Column 79-80 (INUNT)	-	Data input logical unit number (right justified). If columns 79-80 (INUNT) are 5, the program assumes the remaining namelist ($NAM2) data cards are to be read from the card reader. If columns 79-80 are zero, blank or 10 the program assumes the data case described by the variables on this card was prepared by the Preprocessor Program and is to be found on random access mass storage unit 10 and mass storage or tape unit 12. The program will then search unit 12 (directory) for this case to determine the location on unit 10 (inventory) where the case is to be found. The data is then initially read from unit 10 and at the completion of this read, will also read namelist $NAM2 from the card reader. This second read of the namelist data is for any updates to the main data. If there are no updates, include only a $NAM2 and $END card. At the completion of this case, the program will cycle around for a new case card only if the variable NPS in namelist $NAM2 below is zero.

The namelist data variables are read after the case identification card and only if column 1 (NVHCLC) is not zero and not blank. The namelist format is given in Section B.4 for those users not familiar with namelist input.

NAMCAS - 72 Hollerith characters of general case identification information. This information is printed in addition to the adjusted cloud stabilization height, range and azimuth bearing and the date and time of the run as a title page to the output listing.

TESTNO - The first 36 Hollerith characters (TESTNO (1) - TESTNO (6) contain the meteorological case information. This information is printed in the page heading and plot titles following the words "THE METEOROLOGICAL CASE IS".

Characters 37 through 60 (TESTNO (7) - TESTNO (10) contain the name of the rocket vehicle for use in the page heading. (e.g. TITAN IIIC)

Characters 61 through 72 (TESTNO (11) - TESTNO (12) contain the name of the pollutant only if it is not HCl, CO, CO_2, or Al_2O_3. (e.g. NO_x).

NPS - This parameter is used to indicate multiple cases.

If NPS is set to 0, the Program assumes there is another case to follow and cycles to read the next case identification card (data card 1).

If NPS is set to 1, the Program assumes this is the last case to process and summarizes all cases processed at the end of the output listing and stops.

ISKIP - Program control option array.

ISKIP (1) - This option, if set non-zero, indicates patterns of concentration, dosage, time-mean concentration, deposition, etc. are to be calculated and printed on the polar reference grid system defined by XX and YY below. The grid system origin is the vehicle launch site and all calculation distances are relative to the origin. This option is the ISW(12) option in the Preprocessor Program.

ISKIP (2) - This option, if set non-zero, is used to calculate maximum centerline values of concentration, dosage, time-mean concentration, and/or deposition along the cloud trajectory relative to the launch site. This option is the ISW(13) option in the Preprocessor Program.

If ISKIP (2) is set equal to 1, the model calculations are printed.

If ISKIP (2) is set equal to 2, the model calculations are plotted.

If ISKIP (2) is set equal to 3, the model calculations are both printed and plotted.

The maximum centerline concentration, dosage, time-mean concentration and deposition are determined by the use of a spline function. At each radial distance (XX) from the origin, the Program determines a curve via the cubic spline that passes through each angular (azimuth bearing YY) grid coordinate with the calculated maximum roughly in the midpoint of the curve. The Program will then determine the maximum value and output, the range and azimuth bearing to that maximum

ISKIP (3) - This option, if set non-zero, is used to calculate isopleths of concentration, dosage, time-mean concentration and/or deposition. This option is the ISW(14) option in the Preprocessor Program.

If ISKIP (3) is set equal to 1, the isopleths are printed.

If ISKIP (3) is set equal to 2, the isopleths are plotted.

If ISKIP (3) is set equal to 3, the isopleths are both printed and plotted.

ISKIP (4) - This option is used only with the calculation of ground-level precipitation deposition (Model 5). This option is the ISW(11) option in the Preprocessor Program.

If ISKIP (4) is set non-zero, the maximum possible ground-level precipitation deposition is calculated at points downwind from the cloud position. These calculations are independent of the elapsed time from T1M1 to the calculation point.

If ISKIP (4) is set equal to zero, the calculated precipitation deposition at points downwind from the cloud position at time T1M1 is dependent upon the elapsed time from T1M1 to the points.

ISKIP (5) - This option controls the pollutant name and units printed in the page heading and plot legend:

If ISKIP (5) is set equal to 1, the units of calculated HCl concentrations are in parts per million (ppm) and dosage units are in parts per million seconds. If HCl precipitation deposition is being calculated (Model 5), the units of deposition are pH (surface water acidity) or milligrams per square meter depending on ISKIP(9) below.

If ISKIP (5) is set equal to 2, the units of calculated CO concentrations are in parts per million (ppm) and dosage units are in parts per million seconds.

If ISKIP (5) is set equal to 3, the units of calculated CO_2 concentrations are in parts per million (ppm) and dosage units are in parts per million seconds.

If ISKIP (5) is set equal to 4, the units of calculated Al_2O_3 concentration are in milligrams per cubic meter (mg/m^3) and dosage units are in milligram seconds per cubic meter.

If TESTNO (11) above is non-blank, then ISKIP (5) is used only for units selection and the pollutant name is taken from TESTNO (11). Also, calculated gravitational deposition (Model 6) is in units of milligrams per square meter.

ISKIP (6) - This option is used for printing purposes only and gives the type of vehicle launch for which calculations are being made and inserts the following in the page heading and plot legend.

If ISKIP (6) is set equal to 1, a "STATIC FIRE" is assumed.

If ISKIP (6) is set equal to 0 or 2, a "NORMAL LAUNCH" is assumed.

If ISKIP (6) is set equal to 4, a "SLOW BURN" is assumed.

If ISKIP (6) is set equal to 5, the program omits this option from the pageheading and plot legend.

ISKIP (7) - This option controls the meteorological data used with Model 4.

If ISKIP (7) is set equal to zero, the Program assumes Model 4 is being used to determine concentration, dosage, etc., in a layer where the pollutant distribution at cloud stabilization varies substantially with height. The meteorological data used in Model 4 is automatically determined from the meteorological inputs assigned to the initial layers or sublayers.

If ISKIP (7) is set equal to 1, the Program assumes Model 4 is being used to determine concentration, dosage, etc., resulting from changes in the meteorological layer structure. The meteorological data used in Model 4 after time TAST (time of layer structure change measured from time of cloud stabilization) is taken from the input parameters ALPHL through TEMPL.

ISKIP (8) - This option, if set non-zero, prints a detailed listing of all Program inputs.

ISKIP (9) - If set to zero, output of precipitation deposition (Model 5) is assumed in milligrams per square meter.

If set to 1, output of precipitation deposition for HCl only is assumed in pH (surface water acidity). If ISKIP (9) is set to 1, all calculation and program output assumes that 0 is the maximum possible pH and 14 is the minimum possible pH in terms of acidity.

NXS - Number of radial distances (range) XX in the polar reference grid system. If NXS is set $\leq$ 0, the default value of 41 is used for NXS and the array XX is automatically filled from values shown in Table B-3.

NYS - Number of aximuth bearings in the polar reference grid system. If NYS is set $\leq$ 0, this parameter is automatically calculated and the array of azimuth bearing coordinates (YY) is automatically filled. The value of NYS includes sufficient points in YY to provide a calculation pattern spanning 100 degrees (see Table B-3, note 9).

NZS - Total number of initial layer boundaries including the ground surface boundary.

NCI, NDI, NTI - These parameters each contain two values used in the maximum centerline calculations under ISKIP(2) and in the calculation of isopleths under ISKIP(3).

The total number of isopleth values is given in the hundreds and tens positions of NCI, NDI and/or NTI. If these positions are zero, isopleths for the respective quantity (concentration, dosage, time-mean concentration and/or deposition) is not calculated. The number of critical pollutant levels (air quality standards) to be identified in the plots for maximum centerline calculations is given in the units position of NCI, NDI and/or NTI. If this position is zero, no plot is generated. If set to 9, a plot is generated without indicators for critical pollutant levels (air quality standards).

If the units position of NCI, NDI and/or NTI is greater than zero and not equal to 9, the critical pollutant levels (standards) must be punched as the first values in the arrays CI, DI and/or TI below.

NPTS - Number of heights at which calculations are to be made. If NPTS is set equal to zero or omitted, NPTS is defaulted to 1 and ZZL (1) below is set equal to zero.

NVS - Number of droplet or particle terminal fall velocities used to calculate ground-level gravitational deposition from all layers except the layer in which a destruct occurs (Model 6 only).

NVB - Number of droplet or particle terminal fall velocities used to calculate ground-level gravitational deposition from the layer in which a vehicle destruct occurs (Model 6 only).

XX - Array of radial distances (range) for the coordinates used in calculations on the reference grid system. This array is automatically filled if NXS = 0, (see NXS above). The last 2 points in XX are used only for calculating isopleths; the second to last point should equal 1.2 times the third to the last point and the last point should equal 1.5 times the third to the last point. Space the XX values uniformly and use as many as the program will allow. The user is cautioned to use the default values unless another grid is required.

YY - Array of azimuth bearings for the coordinates used in calculations on the reference grid system measured clockwise from zero degrees north. This array is automatically filled if NYS = 0 (see NYS above). Space the YY values densely toward the center of the calculation sector and use as many as the program will allow. The user is cautioned to use the default values unless another grid is required.

Z - Array of layer boundary heights in ascending order beginning with the surface boundary height (the first layer is always the surface layer).

DELX - Array of the radial distances (range) from the source location (point of cloud stabilization) in each layer to the center of the reference grid system (launch site).

DELY - Array of azimuth bearings to the source location (point of cloud stabilization) in each layer, measured clockwise from zero degrees north.

Q - Source strength within each initial layer. The source strength input units depend upon the model used and the pollutant for which calculations are being made. Table B-1 gives the appropriate input units for each model pollutant combination.

UBARK - Mean wind speed at ZRK followed by the mean wind speed at the top of each layer.

SIGAK - Standard deviation of the wind azimuth angle for reference time τ_{oK} at ZRK followed by the standard deviation of the wind azimuth angle at the top of each layer.

SIGEK - Standard deviation of the wind elevation angle at ZRK followed by the standard deviation of the wind elevation angle at the top of each layer.

SIGXO - Standard deviation of the alongwind concentration distribution of the source in the layer (alongwind source dimension).

SIGYO - Standard deviation of the crosswind concentration distribution of the source in the layer at a downwind distance XLRY from the true source (crosswind source dimension). The default value is SIGXO.

SIGZO - Standard deviation of the vertical concentration distribution of the source in the layer at a downwind distance XLRZ from the true source (vertical source dimension).

TABLE B-1

SOURCE STRENGTH INPUT UNITS

Model	Pollutant	
	HCL, CO, CO_2	AL_2O_3
1	1	2
2	1	2
3	1	2
4	1	2
5	2*	2
6	2	2

Code definition for Table B-1:

- ① $Q = Q' \frac{22.4}{M} \frac{T}{273.16} \frac{1013.2}{P}$

  (Concentration output units are parts per million (PPM)

- ② $Q = Q'$

  where

  Q = Source strength in each initial layer

  Q' = Total weight of the material in the layer in milligrams

  T = Surface temperature in degrees Kelvin

  P = Surface pressure in millibars

  M = Molecular weight of the material

*If HCl precipitation deposition (Model 5) in pH units is being calculated, then

TABLE B-1 (Concluded)

$$Q = \left(Q' \times 10^{-3} \times \frac{1}{\left(\text{Rate } \frac{\text{in.}}{\text{hr.}}\right)} \times \frac{1}{25.4} \times \frac{1}{\text{Mole. Wt. (gr)}} \times \frac{1}{\text{duration (hr)}}\right)$$

or for maximum HCl precipitation deposition in pH units

$$Q = \left(Q' \times 10^{-3} \times \frac{1}{\left(\text{Rate } \frac{\text{in.}}{\text{hr.}}\right)} \times \frac{1}{25.4} \times \frac{1}{\text{Mole. Wt. (gr)}}\right)$$

(Deposition output units for Model 5 is milligrams per square meter (mg/m^2). However, deposition output can be in pH units for HCl depending on ISKIP(9).)
Deposition output units for Model 6 is milligrams per square meter (mg/m^2) and concentration output units for Models 1 through 4 are milligrams per cubic meter (mg/m^3).

ALPHA - Lateral diffusion coefficient in the layer (default value is 1).

BETA - Vertical diffusion coefficient in the layer (default value is 1).

ZRK - Reference height in the surface layer for meteorological measurements (default value is 2 meters).

TEMPK - Virtual potential temperature at each layer boundary z. This parameter is used only in the calculation of the wind speed shear in the layer. If the wind speed shear is negative and the difference between the virtual potential temperature at the top and bottom of the layer is also negative, the Program will use the absolute value of the speed shear. If the temperature difference is positive or zero, the program will use a wind speed shear of zero. If the layer wind speed shear is positive or zero, the virtual potential temperature difference is not used.

TIMAV - Time over which time-mean concentration and average cloud concentration are calculated (default value is 600 seconds except for CO, where it is 300 seconds).

THETAK - Mean wind direction at ZRK followed by the mean wind direction at the top of each layer.

TAUK - Time required for cloud stabilization

TAUOK - Reference time for the standard deviations of the wind azimuth angle SIGAK (default value is 600 seconds).

H - Adjusted cloud stabilization height.

XRY - Distance downwind from a virtual point source over which rectilinear expansion in the lateral occurs (default value is 100 meters).

XLRY - Reference from the true source at which SIGYO is measured (default value is zero).

XLRZ - Reference distance from the true source at which SIGZO is measured (default value is zero).

ZZL - Vertical calculation heights. This parameter can include any heights within the initial layer structure (default value is zero).

IZMOD - This parameter designates the model number or numbers for use in each input layer. A brief description of the six Program models is given below and a complete mathematical description of each model is given in Section 3 of the main body of the report given in the introduction. The possible model number combinations input into IZMOD are given in Table B-2.

1 - Model 1, the source extends vertically through the entire initial layer and turbulent mixing is occurring. It is assumed that the vertical distribution of material is uniform with height and the distributions of material along the along-wind and the crosswind cloud axes are Gaussian. The digit 1 is included in the array IZMOD for each layer in which Model 1 is to be used. Also, if any digit of IZMOD is 0, the Program assumes Model 1 has been designated.

2 - Model 2 refers to the same source configurations as Model 1 in that the source extends vertically through the entire depth of the layer and the distribution of material is uniform with

TABLE B-2

POSSIBLE INPUT MODEL NUMBER COMBINATIONS

IZMOD[1]	PROGRAM ASSUMES CALCULATIONS ARE MADE USING:
0	Model 1
1	Model 1
2	Model 2
3	Model 3
14	Model 1 is used prior to layer transition and Model 4 is used after layer transition occurs at time TAST
24	Model 2 is used prior to layer transition and Model 4 is used after layer transition occurs at time TAST
34	Model 3 is used prior to layer transition and Model 4 is used after layer transition occurs at time TAST
4	Model 4 is used to accomodate to a variation of source strength in the layer and layer transition is immediate (TAST = 0)
5	Model 5 is used and the layer structure and source distribution is assumed to be that of Model 1 when only the digit 5 is given in IZMOD. The digit 5 can be combined with any of the above digit combinations (145, 45, 35, etc.). When a 5 is combined with any of the above digit combinations the Program assumes the layer structure and source distribution of that combination are used with Model 5.
6	Model 6

1 The digits under IZMOD can appear in any order. For example, 14 is the same as 41 and 154 is the same as 415.

height. In Model 2, however, it is assumed that no turbulent mixing is occurring. The digit 2 is included in the array IZMOD for each layer in which Model 2 is to be used in the calculations (IZMOD = 2, 2, 2, etc.).

3 - Model 3 differs from Models 1 and 2 in that the vertical extent of the source is less than the depth of the layer. The model equation thus contains vertical expansion terms. The digit 3 is input to IZMOD for Model 3 (IZMOD = 3).

4 - Model 4, the layer-transition model, may be used to calculate concentration and dosage resulting from changes in the meteorological layer structure. Model 4 may also be used to calculate concentration and dosage in a layer where the pollutant distribution at cloud stabilization varies substantially with height.

The application of Model 4 requires the following assumptions:

- The boundaries between adjacent initial layers or sublayers is eliminated (at time TAST) and the layers are replaced by a single layer
- Turbulent mixing is occurring in the resultant single layer
- The material in each of the initial layers or sublayers is (before time TAST) uniformly distributed in the vertical
- Reflection occurs at the upper and lower boundaries of the resultant single layer

4 - Model 4, the layer-transition model, may be used to calculate concentration and dosage resulting from changes in the meteorological layer structure. Model 4 may also be used to calculate concentration and dosage in a layer where the pollutant distribution at cloud stabilization varies substantially with height.

The application of Model 4 requires the following assumptions:

- The boundaries between adjacent initial layers or sublayers is eliminated (at time TAST) and the layers are replaced by a single layer
- Turbulent mixing is occurring in the resultant single layer
- The material in each of the initial layers or sublayers is (before time TAST) uniformly distributed in the vertical
- Reflection occurs at the upper and lower boundaries of the resultant single layer

If the parameters TAST and ISKIP (7) are both set to zero (or omitted from the inputs) and Model 4 is specified for use, the program assumes the function of the model is to accommodate variations in the pollutant distribution with height in the layer at cloud stabilization. For example, the surface mixing layer can be initially divided into several sublayers where the source strength, although assumed to be vertically uniform in each sublayer, varies from layer to layer. In this case the initial layers are immediately reduced to a single layer and Model 4 calculates the contribution from each of the initial sublayers to the composite concentration and dosage field by permitting turbulent mixing across the initial layer boundaries. IZMOD would contain the digit 4 for each of the respective initial sublayers that comprise the resultant single layer.

If Model 4 is to be used to predict the concentration and dosage fields downwind from a change in meteorological structure, the meteorological parameters of the new resultant layer or layers must be specified. Also, the parameter ISKIP (7) must be set equal to 1 and the parameter TAST set equal to the time (after cloud stabilization) at which the layer transition (meteorological structure change) occurs. Each of the initial sublayers that are to be included in a single layer after laver transition are specified by including the digit 4 in the array IZMOD. For example, assume layers 1 through 4 are to be reduced to a single layer after layer transition and layers 5 and 6 are also reduced to a single layer. The first four values of IZMOD would include a 4, but they would also include the number of the model to be used prior to layer transition (14, 24 or 34). The values of IZMOD (5) and (6) for layers 5 and 6 would include a 9 and 4, respectively. The 9 is a special flag to separate the resultant 2 layers after layer transition. Also, these last two values would include the model number to be used prior to layer transition (14, 24 or 34). If Model 1 was to be used with 4 in the above example the IZMOD inputs would be coded as IZMOD = 4, 4, 4, 4, 9, 4 (or IZMOD = 4*4, 9, 4, or IZMOD = 4*14, 19, 14, etc.).

5 - Model 5 is used to calculate the amount of material on the surface by precipitation scavenging. The digit 5 must be included in the array IZMOD for each initial sublayer through which precipitation is occurring. Model 5 uses the layer structure and source distribution defined by any one of Models 1 through 4. Thus, the array IZMOD must include the appropriate model number for each layer that describes the layer structure and source distribution. For example, assume that Model 4 is being used to accommodate to variations in the pollutant distribution with height in the surface mixing layer at cloud stabilization and that the surface mixing layer has been divided into 6 initial sub-layers in which the distribution of material can be

considered uniform. Also, assume that precipitation is occurring through all 6 layers. The array IZMOD would then contain six values equal to 45 for each layer 1 through 6 (IZMOD = 6*45).

6 - Model 6 is used to calculate the surface deposition due to gravitational settling. The basic source configuration is a volume source of finite lateral extent and unit vertical extent. Other source configurations are treated by summing the deposition at the ground resulting from a number of basic sources arranged to simulate the desired configuration. The model is essentially a tilted plume model in which the effects of wind shear are taken into account. The axis of a particle or droplet cloud of a given settling velocity intersects the ground plane at a distance from the source and at an angle from the mean surface wind direction that are proportional to the total angular wind shear and the residence time of the settling material in the layers between the source and the ground surface. In any layer, the inclination of the cloud axis from the horizontal is given by $\tan^{-1} V_s / \bar{u}$, where V_s is the particle or droplet settling velocity and $\bar{u}$ is the mean transport wind speed in the layer. In all cases, material released in the K^{th} layer and dispersed upwards by turbulence is assumed to be reflected downward at the interface of the K^{th} and $(K + 1)^{th}$ layers. The basic model is used to calculate the ground-level deposition pattern for a single value of the settling velocity. The total deposition pattern is obtained by summing the results for all settling velocities representative of the particle or droplet-size distribution of the released material on a reference coordinate grid system.

Only IZMOD (1) need be set equal to 6 as no other model can be executed in the same case.

DECAY - Coefficient of time-dependent decay. If DECAY is set > 0, then concentration, dosage, time-mean concentration, etc., are calculated with decay (Does not effect Model 5 or Model 6).

ZLIM - This parameter is the maximum height through which precipitation can occur. If Model 5 is selected, ZLIM is automatically determined from IZMOD. If concentration, dosage, etc., are being calculated with precipitation occurring (BLAMDA > 0.0), ZLIM is equal to the upper boundary of the uppermost layer in which precipitation occurs (ZLIM is defaulted to Z(NZS)).

BLAMDA - Precipitation scavenging (washout) coefficient. If Model 5 is selected, this parameter must be greater than 0. Also, if Model 1, 2, 3 or 4 is selected with BLAMDA > 0 and without Model 5, the Program assumes concentration, dosage, etc., are to be calculated with precipitation occurring.

$$\text{BLAMDA} \cong 5.2 \times 10^{-4} \left(\text{Rate}\left(\frac{\text{in}}{\text{hr}}\right)\right)^{0.567} \text{sec}^{-1}$$

TIM1 - Time of start of precipitation measured from the time of cloud stabilization. (Not used for maximum precipitation deposition).

CI, DI and TI - Arrays of concentration, dosage and time-mean concentration values respectively for which isopleths are calculated. There can be two groups of data in each of these arrays, where both of the groups are arranged in descending order. The values in the first group are critical pollutant levels (air quality standards). The number of values in this group is given in the units position of the parameters NCI, NDI and NTI respectively. The second group of values includes all other isopleth levels desired. The total number of values in CI, DI and TI is given in the hundreds

and tens positions of NCI, NDI and NTI respectively. If precipitation, deposition or gravitational deposition is being calculated, the array DI is used for these quantities.

TAST - Time of layer structure change (Model 4) measured from the time of cloud stabilization.

GAMMAP - This parameter is 1 minus the fraction of material reflected at the surface (partial reflection). If this parameter is set to 0, the Program assumes complete reflection; if set equal to .4, 60 percent (.6) reflection is assumed; and, if set equal to 1, no reflection is assumed. If Model 6 is selected and partial reflection is desired, the array GAMMAP must have a value for each particle settling velocity category. For all other models, only GAMMAP (1) need be set.

VS - Droplet or particle terminal fall velocity distribution used in all layers except a layer in which a vehicle destruct occurs (Model 6 only).

PERC - Frequency of occurrence of each velocity category VS (Model 6 only).

ACCUR - Accuracy constant for the line source simulation used in Model 6. A value of 0.45 ensures that the calculated ground deposition is within 10 percent of the deposition expected from a vertical line source. If ACCUR is set to 0.32, the calculated deposition is within 5 percent of that expected from a vertical line source.

VB - Droplet or particle terminal fall velocity distribution used in the layer in which a vehicle destruct occurs. The layer must be the top layer (Model 6 only).

PERCB - Frequency of occurrence of each velocity category VB (Model 6 only).

SCL - Map scale factor in inches for isopleth plots. If the map scale factor is 1 inch = 24000 inches, SCL would be input as 24000. If set to zero, the Program will scale the isopleths within the boundaries defined by XSIZE and YSIZE below.

XMAXIN - Maximum alongwind distance from the launch site in meters for isopleth plots. If set to zero, the Program will use XX(NXS-2) as the maximum distance.

YMAXIN - Maximum crosswind distance for isopleth plots in meters. If set to zero, the Program will calculate YMAXIN.

XSIZE - The number of raster counts on the SC4020 in the X or east-west horizontal plot axis for isopleths. If set to zero, the Program will use 937.

YSIZE - The number of raster counts on the SC4020 in the Y or north-south vertical plot axis for isopleths. If set to zero, the Program will use 899.

RASTIN - The number of raster counts per inch on the SC4020 for isopleth plots. If input as zero, the Program uses 163.2.

XCIZE - The number of raster counts on the SC4020 on the X or alongwind horizontal axis for maximum centerline plots. If set to zero, the Program uses 937.

YCIZE - The number of raster counts on the SC4020 on the vertical axis for maximum centerline plots. If set to zero, the Program uses 899.

XMAXJN - Maximum alongwind distance in meters from the launch site for maximum centerline plots. If set to zero, the Program uses XX(NXS-2).

YMAXJN - Maximum number of log cycles for the vertical axis of the maximum centerline plots if ISW below equals 0 or 2. Maximum value of the vertical axis if ISW below equals 1. If set to zero, the Program determines YMAXJN.

ISW - Maximum centerline plotting flag. If ISW is set to 0 or 2, the Program plots maximum centerline versus distance on a log-log plot. If set to 1, the plot is linear on both axes.

JSW - Isopleth plot switch. If JSW is set equal to 0, the Program will fit a cubic spline function to the discrete isopleth points and plot a smooth curve through the points. If JSW is set equal to 1, the Program will not use the spline function but will plot straight lines between adjacent calculated isopleth points. This option has been included because the spline function sometimes fails to fit the data points when the isopleths are sharply curved. These cases are recognized by a high frequency oscillation along the plotted curve and can be corrected by smoothing the curve by hand or replotting with JSW set equal to 1.

The layer step change (transition) parameters below are used only if ISTEP (7) equals 1 and Model 4 has been selected. These parameters are used only when Model 4 is being used to predict the concentration and dosage downwind from a change in meteorological structure (see IZMOD, Model 4 above).

ALPHL - Lateral diffusion coefficient in each new layer (Default value is 1).

BETL - Vertical diffusion coefficient in each new layer (Default value is 1).

TAUL - Time required for cloud stabilization in the new layers.

TAUOL - Reference time for the standard deviation of the wind azimuth angle SIGAL in the new layers (Default value is 600).

ZRL - Reference height in the surface layer for meteorological measurements. This must be set only if the new bottom layer includes the initial surface layer (Default value is 2).

UBARL - Mean wind speed at the bottom and top boundaries of each new layer. These values are input in ascending order of new layers with the value at the top boundary preceded by the bottom. If the new bottom layer contains the initial surface layer, UBARL at ZRL should be input as the bottom value of this layer.

SIGAL - Standard deviation of the wind azimuth angle for reference time τ_{oL} at the bottom and top boundaries of each new layer. If the new bottom layer contains the initial surface layer, SIGAL at ZRL should be input as the bottom value of this layer.

THETAL - Mean wind direction at the bottom and top boundaries of each new layer. If the new bottom layer contains the initial surface layer, THETAL at ZRL should be input as the bottom value of this layer.

TEMPL - Virtual potential temperature at the bottom and top boundaries of each new layer.

B.3 CONDENSED TABLE OF NAMELIST INPUT PARAMETERS

The namelist data input parameters required for the NASA/MSFC Multilayer Diffusion Program are given in condensed form in Table B-3. The information categories in the table are defined as follows:

NAMELIST - Name of the FORTRAN NAMELIST list to which the variables belong

FORTRAN - Fortran symbolic notation defining the program input

MODEL - Mathematical notation corresponding to the FORTRAN notation

UNITS - Dimensional units of the input parameters

LIMITS - Numberical limits on input values

VALUE - Default value should the parameter have a value of 0

ARRAY SIZE - Maximum number of core locations for the input parameter

TABLE B-3

TABLE OF INPUT PARAMETERS

NAMELIST	FORTRAN	Model	Units	Limits	Value (3)	Array Size (7)
NAM2	TESTNO	N/A	N/A	N/A	Blanks	12
	NAMCAS	N/A	N/A	N/A	Blanks	12
	ISKIP	N/A	N/A	(1)	0	15
	NXS	N/A	N/A	≤41	41	1
	NYS	N/A	N/A	≤41	41	1
	NZS	N/A	N/A	≤16	0	1
	NDI	N/A	N/A	≤103 (10)	0	1
	NCI	N/A	N/A	≤103 (10)	0	1
	NTI	N/A	N/A	≤ 103 (10)	0	1
	NPTS	N/A	N/A	≤40	1	1
	NVS	N/A	N/A	≤20	0	1
	NVB	N/A	N/A	≤20	0	1
	XX	R	Meters	>0.0	(8)	41
	YY	A	Degrees	0.0≤Φ ≤360.0	(9)	41
	NPS	N/A	N/A	0 or 1	0	1
	Z	z_{Bl} and z_{TK}	Meters	≥0.0	z(1) = 0.0	16

TABLE B-3

TABLE OF INPUT PARAMETERS

(Continued)

NAMELIST	FORTRAN	Model	Units	Limits	Value (3)	Array Size (7)
NAM2	DELX	R	Meters	≥ 0.0	0.0	15
	DELY	A	Degrees	$0.0 \leq \phi \leq 360.0$	0.0	15
	Q	Q	(2)	≥ 0.0	0.0	15
	UBARK	$\bar{u}_R$ and $\bar{u}_{TK}$	Meters Sec^{-1}	≥ 0.1	0.1	16
	SIGAK	$\sigma_{AR}\{\tau_o\}$ & $\sigma_{ATK}\{\tau_o\}$	Degrees	≥ 0.5	0.5	16
	SIGEK	σ_{ER} & σ_{ETK}	Degrees	≥ 0.1	0.1	16
	SIGXØ	$\sigma_{xo}\{K\}$	Meters	> 0.0	N/A	15
	SIGYØ	$\sigma_{yo}\{K\}$	Meters	> 0.0	SIGXØ	15
	SIGZØ	$\sigma_{zo}\{K\}$	Meters	≥ 0.0	0.0	15
	ALPHA	α_K	N/A	≥ 0.0	1.0	15
	BETA	β_K	N/A	≥ 0.0	1.0	15
	ZRK	z_R	Meters	$\geq z(1)$	2.0	1
	TIMAV	T_A	Seconds	≥ 0.0	600 or 360	1
	THETAK	θ_{B1} & θ_{TK}	Degrees	$0.0 \leq \theta_K \leq 360.0$	0.0	16

TABLE B-3

TABLE OF INPUT PARAMETERS

(Continued)

NAMELIST	FORTRAN	Model	Units	Limits	Value (3)	Array Size (7)
NAM2	TAUK	τ	Seconds	>0.0	N/A	1
	TAUOK	τ_o	Seconds	≥0.0	600.0	1
	H	H	Meters	≥0.0	0.0	1
	XRY	x_{ry}	Meters	≥0.0	100.0	1
	XRZ	x_{rz}	Meters	≥0.0	100.0	1
	XLRY	x_{Ry}	Meters	≥0.0	0.0	1
	XLRZ	x_{Rz}	Meters	≥0.0	0.0	1
	ZZL	z	Meters	≥0.0	0.0	1
	IZMØD	N/A	N/A	(11)	1	15
	DECAY	k	$Seconds^{-1}$	≥0.0	0.0	1
	ZLIM	z_{lim}	Meters	$= z_{TK}$	Z(NZS) (12)	1
	TIMI	t_1	Seconds	≥0.0	(5)	1
	BLAMDA	A	$Seconds^{-1}$	≥0.0	(5)	1
	DI	$D_K(x_K, y_K, z_K)$	(4)	≥0.0	(5)	10
	CI	$x_K(x_K, y_K, z_K)$	(4)	≥0.0	(5)	10
	TI	$x_K(x_K, y_K, z_K; T_A)$	(4)	≥0.0	(5)	10

TABLE B-3

TABLE OF INPUT PARAMETERS

(Continued)

NAMELIST	FORTRAN	Model	Units	Limits	Value (3)	Array Size (7)
NAM2	TAST	t^*	Seconds	≥0.0	0.0	5
	TEMPK	Φ_{BI} & Φ_{TK}	Degrees K	≥0.0	0.0	16
	VS	V_s	Meters sec^{-1}	≥0.0	(5)	20
	PERC	f_i	N/A	>0.0	(5)	20
	ACCUR	R_c	N/A	(6)	(5)	20
	VB	V_{SK}	Meters Sec^{-1}	>0.0	(5)	20
	PERCB	f_i	N/A	>0.0	(5)	20
	HB	H_{SK}	Meters	≥0.0	0.0	1
	GAMMAP	$1-\gamma_r$	N/A	≥0 & ≤1	0.0	20
	ALPHL	α_L	N/A	≥0.0	(13)	5
	BETL	β_L	N/A	≥0.0	(13)	5
	TAUL	τ	Seconds	>0.0	TAUK	1
	TAUØL	τ_o	Seconds	≥0.0	TAUØK	1
	ZRL	z_{RL}	Meters	≥2.0	ZRK	1
	UBARL	$\bar{u}_{BL}$ & $\bar{u}_{TL}$	Meters Sec^{-1}	≥0.0	(12)	10
	SIGAL	$\sigma_{ABL}\{\tau_o\}$ & $\sigma_{ATL}\{\tau_o\}$	Degrees	≥0.0	(12)	10

TABLE B-3

TABLE OF INPUT PARAMETERS

(Continued)

NAMELIST	FORTRAN	Model	Units	Limits	Value (3)	Array Size (7)
NAM2	SIGEL	σ_{EBL} & σ_{ETL}	Degrees	≥0.0	(12)	10
	THETAL	θ_{BL} & θ_{TL}	Degrees	≥0.0 & ≤360.0	(12)	10
	TEMPL	Φ_{BL} & Φ_{TL}	Degrees K	≥0.0	0.0	10
	SCL	N/A	Inches	≥0	Calculated	1
	XMAXIN	R	Meters	≥0	Calculated	1
	YMAXIN	N/A	Meters	≥0	Calculated	1
	XSIZE	N/A	Rasters	≥0	937	1
	YSIZE	N/A	Rasters	≥0	899	1
	RASTIN	N/A	Rasters/ Inch	≥0	163.2	1
	XCIZE	N/A	Rasters	≥0	937	1
	YCIZE	N/A	Rasters	≥0	899	1
	XMAXJN	N/A	Meters	≥0	XX(NXS-2)	1
	YMAXJN	N/A	Log Cycles or Meters	≥0	Calculated	1
	ISW	N/A	N/A	1 or 2	2	1
	JSW	N/A	N/A	0 or 1	0	1

TABLE B-3

TABLE OF INPUT PARAMETERS

(Continued)

(1) See Section B-2 for the range of values of the ISKIP options.

(2) Units depend on model; see Section B-2 in the definition of Q.

(3) The column under Value is used to simplify the Program input deck by providing default values should the parameter be intentionally omitted in the first data case or set to zero. All parameters in Table B-3 remain their previous value for all subsequent cases unless changed in the input list.

(4) Units of dosage and concentration isopleth values must be consistent with Program output units, milligrams/meter^3 or parts per million, etc.

(5) These parameters must have values other than zero only if they are used by the model selected and only in the applicable layers.

(6) See Section B-2 for the description of ACCUR.

(7) Several variables are dimensioned to a larger value in the Program, but the extra space is used for other purposes.

TABLE B-3

TABLE OF INPUT PARAMETERS

(Concluded)

(8) The default values of XX are: 500, 1250, 2500, 3750, 5000, 6250, 7500, 8750, 10000, 11250, 12500, 13750, 15000, 16250, 17500, 18750, 20000, 21250, 22500, 23750, 25000, 26250, 27500, 28750, 30000, 31250, 32500, 33750, 35000, 36250, 37500, 38750, 40000, 41250, 42500, 43750, 45000, 47500, 50000, 65000, 80000 meters. Default values of XX are used only if NXS is set to 0.

(9) The default values of the YY are the average layer wind direction $\pm$ 180° rounded to the nearest 5° added to each of the following angles: -40, -35, -30, -27, -24, -22, -20, -18, -16, -14, -12, -10, -8, -7, -6, -5, -5, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 40 degrees.

(10) The limit values given for NDI, NCI and NTI mean there is a maximum of 10 possible isopleth values with a maximum of 3 critical pollutant levels (air quality standards) within the 10. The total number of values is input in the tens and hundreds positions and the number of critical pollutant levels is input in the units position.

(11) IZMØD is a 3 digit integer where any one of the three digits can be an integer from 0 to 6 or the integer 9. See Section B.2 for a complete explanation of IZMØD.

(12) If these parameters are input, both bottom and top values are input respectively for each new layer in the layer step change.

(13) ZLIM is automatically calculated if IZMØD contains a 5 (Model 5).

B.4 DATA INPUT FORMAT

This Program uses the FORTRAN NAMELIST method to input data. Input data must be in a specific form in order to be read using a NAMELIST list. The first character in each card to be read must be blank. The first card in the NAMELIST list contains the NAMELIST name NAM2 preceded by the character $ or &. The last card in the NAMELIST list contains $END (&END) to terminate the list. The form of the remaining data items in the list may be:

a. *Variable Name = Constant* - The *variable name* may be a subscripted array name or a single variable name. Subscripts must be integer constants. The *constant* may be integer, real or Hollerith (nH *alphanumeric characters*) data.

b. *Array Name = Set of Constants* (separated by commas) - The *array name* is not subscripted. The *set of constants* consists of constants of the type integer or real. The number of constants must be less than or equal to the array size. Successive occurrences of the same constant can be represented in the form *k* constant*.

The sequence of the input data parameters within the list is not significant. A more detailed explanation of the FORTRAN NAMELIST can be found in most FORTRAN language manuals. All Program input parameters are set to zero prior to input of the first case. Parameters that are not used or have default values need not appear in the input deck. When multiple cases are stacked, all parameters retain their values from the last case and are changed only by input.

B. 5 FORTRAN SOURCE LISTING FOR THE NASA/MSFC MULTILAYER DIFFUSION PROGRAM — VERSION 6

This section contains the complete FORTRAN source listing of the NASA/MSFC Multilayer Program — Version 6.

```
      **  NASA/MSFC MULTILAYER DIFFUSION PROGRAM -- VERSION 6       **
      **                                                            **

      PROGRAM MODEL, VERSION 6,  REVISION 0

C     ***********************************************************************MDL00100
C     *     NASA/MSFC MULTILAYER DIFFUSION PROGRAM - VERSION 6                MDL00200
C     ***********************************************************************MDL00300
C                                                                             MDL00400
C       THIS VERSION OF THE NASA/MSFC MULTILAYER MODEL REQUIRES THE USE       MDL00500
C       OF MASS STORAGE LOGICAL UNIT 9 AND 13. THE NUMBER OF TRACKS CAN       MDL00600
C       BE THE SYSTEM DEFAULT. ALSO, IF INUNT BELOW EQUALS 0 OR 10 OR IF      MDL00700
C       NVHCLC BELOW EQUALS 0 THE PROGRAM REQUIRES MASS STORAGE LOGICAL       MDL00800
C       UNITS 10 AND 11 AND TAPE OR MASS STORAGE LOGICAL UNIT 12. THESE       MDL00900
C       UNITS ARE THE SAME AS THOSE USED BY THE PREPROCESSOR PROGRAM. MASS    MDL01000
C       STORAGE UNIT 10 REQUIRES AT LEAST 14 POSITIONS ON THE UNIVAC 1108     MDL01100
C       AND FILES 12 AND 11 CAN BE THE SYSTEM DEFAULT.                        MDL01200
C                                                                             MDL01300
C                                                                             MDL01400
C       THIS VERSION OF THE NASA/MSFC MULTILAYER DIFFUSION MODEL              MDL01500
C       IS DESIGNED TO BE USED WITH OR WITHOUT THE MULTILAYER                 MDL01600
C       PREPROCESSOR                                                          MDL01700
C                                                                             MDL01800
C       DATA INPUT SEQUENCE                                                   MDL01900
C                                                                             MDL02000
C  ** DATA CARD1 (READ FOR EACH PASS OF THE PROGRAM UNLESS THE LAST CASE      MDL02100
C                 PROCESSED BY THE PROG HAD THE VARIABLE NPS SET NON-ZERO)    MDL02200
C                                                                             MDL02300
C       NVHCLC - INTEGER REPRESENTING THE VEHICLE TO BE PROCESSED             MDL02400
C                1= TITAN III C, 2= SPACE SHUTTLE, 3= DELTA-THOR 2914         MDL02500
C                4= MINUTEMAN II, 5= DELTA-THOR 3914  (I1 FORMAT, COL 1)      MDL02600
C          $$$ NOTE - IF NVHCLC IS INPUT AS ZERO THE PROGRAM ASSUMES          MDL02700
C                     THAT MULTIPLE CASES HAVE BEEN STACKED ON MASS           MDL02800
C                     STORAGE UNIT 10 AND TAPE OR MASS STORAGE UNIT 12        MDL02900
C                     BY THE PREPROCESSOR. THIS PROGRAM WILL EXECUTE ALL      MDL03000
C                     OF THESE CASES SEQUENTIALLY AND AUTOMATICALLY           MDL03100
C                     WITHOUT ANY ADDITIONAL INPUT. ALL VARIABLES ON          MDL03200
C                     THIS ONE INPUT CARD MUST BE ZERO, I.E. INPUT ONLY       MDL03300
```

```
C                    ONE BLANK CARD.                                          MDL03400
C      METDTC - 3 INTEGER WORD ARRAY FOR THE DATE OF THE MET DATA             MDL03500
C               MODYYR (3I2 FORMAT, COLS 2-7)                                 MDL03600
C      NSNDC - SOUNDING HOUR (00-24) (I2 FORMAT, COL 8-9)                     MDL03700
C      NMODC - MODEL NUMBER (I3 FORMAT, COL 10-12)                            MDL03800
C               REMEMBER TO INPUT THIS NUMBER EXACTLY LIKE THE                MDL03900
C               PREPROCESSOR PRINTS IT IF USING PREPROCESSOR INPUT            MDL04000
C               DATA FROM MASS STORAGE.                                       MDL04100
C      NPLNTC - NUMBER REPRESENTING THE POLLUTANT. 1=HCL, 2=CO,               MDL04200
C               3=CO2, 4=AL2O3   (I1 FORMAT, COL 13)                         MDL04300
C      INUNT - DATA INPUT UNIT NUMBER. IF INUNT IS 0 THE PROGRAM SETS IT      MDL04400
C               TO 10 AND ASSUMES THE CASE IDENTIFIED BY THIS CARD DATA       MDL04500
C               IS TO BE FOUND ON MASS STORAGE UNIT 10 AND TAPE OR MASS       MDL04600
C               STORAGE UNIT 12. THE PROGRAM THEN READS THIS DATA AND ALSO    MDL04700
C               READS NAMELIST NAM2 FROM THE CARD READER FOR ANY UPDATES      MDL04800
C               OR MODIFICATIONS TO THE CASE. IF INUNT IS 5 THE PROGRAM       MDL04900
C               READS ALL REMAINING DATA THROUGH NAMELIST NAM2 VIA THE        MDL05000
C               CARD READER. (I2 FORMAT , COL 79-80)                          MDL05100
C                                                                             MDL05200
C                                                                             MDL05300
C      NAMELIST NAM2 INCLUDES THE VARIABLES - TESTNO,ISKIP,NXS,NYS,NZS,       MDL05400
C      NUI,NCI,NPTS,NTI,TI,NVS,NVB,XX,YY,Z,DELX,DELY,Q,UBARK,SIGAK,SIGEK,     MDL05500
C      SIGXO,SIGYO,GAMMAP,SIGZO,ALPHA,BETA,ZKK,TIMAV,THETAK,TAUK,TAUOK,       MDL05600
C      H,XMY,XRZ,XLRY,ALRZ,ZZL,IZMOD,DECAY,TIM1,BLAMDA,DI,CI,TAST,ZLIM,       MDL05700
C      HB,PERCB,VB,VS,PERC,ACCUR,ALPHL,BETL,TAUL,TAUOL,ZRL,UBARL,SIGAL,       MDL05800
C      SIGEL,THETAL,NPS,NAMCAS,SCL,XMAXIN,YMAXIN,ISW,XMAXJN,YMAXJN,           MDL05900
C      RASTIN,XSIZE,YSIZE,XCIZE,YCIZE,TEMPK,TEMPL,JSW,NVHCL,METDAT,NSND,      MDL06000
C      NMODL,NPLNT (SOME OF THESE VARIABLES ARE AUTOMATICALLY SET BY THE      MDL06100
C      PROGRAM, CONSULT THE DOCUMENTATION BEFORE PROGRAM USE)                 MDL06200
C                                                                             MDL06300
C      SEE SUBROUTINE TAPEIN AND READER FOR INPUT DATA CODING                 MDL06400
C                                                                             MDL06500
C      IMPORTANT PROGRAM VARIABLES                                            MDL06600
C                                                                             MDL06700
C                                                                             MDL06800
C                                                                             MDL06900
C      ISKIP= PROGRAM CONTROL OPTIONS                                         MDL07000
C      H = CLOUD STABILIZATION HEIGHT (METERS)                                MDL07100
```

```
C     Z     = BOUNDARY HEIGHTS OF LAYERS (METERS)                          MDL07200
C     Q = SOURCE STRENGTH IN LAYER                                         MDL07300
C     UBAR = CALCULATED TRANSPORT SPEED IN LAYER                           MDL07400
C     ALPHA = LATERAL POWER LAW EXPANSION COEFFICIENT                      MDL07500
C     BETA  = VERTICAL POWER LAW EXPANSION COEFFICIENT                     MDL07600
C     SIGYO = STANDARD DEVIATION OF THE LATERAL SOURCE DIMENSION (METER)   MDL07700
C     SIGAP = CALCULATED LATERAL DIFFUSION COEFFICIENT IN LAYER            MDL07800
C     SIGXO = STANDARD DEVIATION OF THE ALONG WIND SOURCE DIMENSION        MDL07900
C             (METERS)                                                     MDL08000
C     DELTHP = CALCULATED WIND DIRECTION SHEAR IN LAYER                    MDL08100
C     SIGZO  = STANDARD DEVIATION OF THE VERTICAL SOURCE DIMENSION         MDL08200
C             (METERS)                                                     MDL08300
C     SIGZP = CALCULATED VERTICAL DIFFUSION COEFFICIENT                    MDL08400
C     DELX = RANGE TO SOURCE IN LAYER RELATIVE TO ORIGIN OF REFERENCE      MDL08500
C            GRID SYSTEM (METERS)                                          MDL08600
C     DELY = AZIMUTH BEARING FROM 0 DEGREES NORTH TO SOURCE IN LAYER       MDL08700
C            (DEGREES)                                                     MDL08800
C     THETA = CALCULATED MEAN WIND DIRECTION IN LAYER                      MDL08900
C     ICMOD = MODEL OR MODELS TO USE IN LAYER                              MDL09000
C     DELU  = CALCULATED WIND SPEED SHEAR                                  MDL09100
C     ZZL   = CALCULATION HEIGHTS IN LAYER                                 MDL09200
C     DOS   = CALCULATED VALUE OF DOSAGE                                   MDL09300
C     CON   = CALCULATED VALUE OF CONCENTRATION                            MDL09400
C     PEARD = PART OF DOSAGE EQUATION                                      MDL09500
C     XA = RANGE TO CALCULATION POINT OF THE POLAR COORDINATE REFERENCE     MDL09600
C          GRID SYSTEM (METERS)                                            MDL09700
C     YY = AZIMUTH BEARING FROM 0 DEGREES NORTH TO CALCULATION POINT OF    MDL09800
C          THE POLAR COORDINATE REFERENCE GRID                             MDL09900
C     LAT   = LATERAL TERM OF DOSAGE EQUATION                              MDL10000
C     VER   = VERTICAL TERM OF DOSAGE EQUATION                             MDL10100
C     VREF  = REFLECTION TERM OF DOSAGE EQUATION                           MDL10200
C     T     = SOURCE EMISSION TIME IN LAYER FOR GRAVITATIONAL DEP. (SEC)   MDL10300
C     TESTNO = METEOROLOGICAL CASE INFORMATION                             MDL10400
C      DI = DOSAGE ISOPLETH VALUES OF INTEREST                             MDL10500
C      CI  = CONCENTRATION ISOPLETH VALUES OF INTEREST                     MDL10600
C     TI = TIME MEAN CONCENTRATION VALUES OF INTEREST FOR ISOPLETHS        MDL10700
C     SIGZ = CALCULATED STANDARD DEVIATION OF THE VERTICAL DOSAGE          MDL10800
C            DISTRIBUTION                                                  MDL10900
```

```
C     SIGY = CALCULATED STANDARD DEVIATION OF THE LATERAL DOSAGE          MDL11000
C            DISTRIBUTION                                                 MDL11100
C     SIGA = CALCULATED STANDARD DEVIATION OF THE ALONG WIND DOSAGE       MDL11200
C            DISTRIBUTION                                                 MDL11300
C     SQRTP =  SQUARE ROOT TWO PI                                         MDL11400
C     L     = LENGTH OF CLOUD IN ALONG WIND DIRECTION                     MDL11500
C     I     = INDEX OF X COORDINATES                                      MDL11600
C     J     = INDEX OF Y COORDINATES                                      MDL11700
C     KK    = INDEX OF LAYERS                                             MDL11800
C     K = INDEX OVER CALCULATION HEIGHTS ZZL                              MDL11900
C     SIG1  = TEMP STORAGE                                                MDL12000
C     SIG2  = TEMP STORAGE                                                MDL12100
C     SIG3  = TEMP STORAGE                                                MDL12200
C     TAST  = TIME OF LAYER STRUCTURE CHANGE (SECONDS)                    MDL12300
C     NOK = NO OF DISTINCT GROUPS OF LAYERS THAT FORM INTO ONE AT TIME    MDL12400
C           TAST.                                                         MDL12500
C     ILK   = INDEX ON NEW LAYERS AFTER TIME TAST                         MDL12600
C     NXS   = NO OF X COORDINATES                                         MDL12700
C     NYS   = NO OF Y COORDINATES                                         MDL12800
C     NZS   = NO OF LAYER BOUNDARIES                                      MDL12900
C     NDI   = NO OF DOSAGE ISOPLETHS                                      MDL13000
C     NCI   = NO OF CONCENTRATION ISOPLETHS                               MDL13100
C     NTI = NO OF TIME MEAN CONCENTRATION ISOPLETHS                       MDL13200
C     NPTS = NO OF CALCULATION HEIGHTS ZZL                                MDL13300
C     RAD   = PI/180                                                      MDL13400
C     NNZ   = NZS-1 NO OF LAYERS                                          MDL13500
C     ITOP  = TOP OF NEW LAYER AFTER TAST IN TERMS OF OLD LAYER STRUCTURE  MDL13600
C     IBOT  = BOTTOM OF NEW LAYER AFTER TAST IN TERMS OF OLD LAYER        MDL13700
C             STRUCTURE (ITOP AND IBOT INDEXES)                           MDL13800
C     XAST  = CALCULATE DISTANCE TO TAST                                  MDL13900
C     SIGXNK = SIGX OF NEW LAYER STRUCTURE                                MDL14000
C     BLAMDA=LAMBDA= WASHOUT COEFFICIENT                                  MDL14100
C     TAM1 = TIME OF START OF RAIN (SECONDS)                              MDL14200
C     ZLIM  = MAXIMUM HEIGHT OF WASHOUT                                   MDL14300
C     WASHOU = CALCULATE WASHOUT AT GROUND                                MDL14400
C     UBARK = WIND SPEED AT EACH LAYER BOUNDARY, LOWER BOUNDARY OF LAYER  MDL14500
C             1 FOR UBARK IS ASSUMED AT ZRK  (METERS/SEC)                 MDL14600
C     SIGAK = SIGAP (INITIAL) AT EACH LAYER BOUNDARY, LOWER BOUNDARY OF   MDL14700
```

```
C                LAYER 1 FOR SIGAK IS ASSUMED AT ZRK (DEGREES)                  MDL14800
C      SIGEK = SIGEP (INITIAL) AT EACH LAYER BOUNDARY. LOWER BOUNDARY OF        MDL14900
C                LAYER 1 FOR SIGEK IS ASSUMED AT ZRK (DEGREES)                  MDL15000
C      ZRK = REFERENCE HEIGHT IN SURFACE LAYER (METERS)                         MDL15100
C      THETAK = WIND DIRECTION AT LAYER BOUNDARIES (DEGREES)                    MDL15200
C      TAUK  = TIME IN SECONDS REQUIRED FOR LATERAL CLOUD STABILIZATION         MDL15300
C      TAUOK = SAMPLING PERIOD IN SECONDS AT THE TOP OF THE LAYER               MDL15400
C      DECAY = DECAY COEFFICIENT IN DOSAGE EQUATION                             MDL15500
C      UBARL = WIND SPEED AT BOTTOM AND TOP OF EACH NEW LAYER AFTER LAYER       MDL15600
C                CHANGE  (METERS/SEC)                                           MDL15700
C      SIGAL = SIGAP AT BOTTOM AND TOP OF EACH NEW LAYER AFTER LAYER            MDL15800
C                CHANGE  (DEGREES)                                              MDL15900
C      SIGEL = SIGEP AT BOTTOM AND TOP OF EACH NEW LAYER AFTER LAYER            MDL16000
C                CHANGE  (DEGREES)                                              MDL16100
C      ZRL = REFERENCE HEIGHT IN SURFACE LAYER OF NEW STRUCTURE (METERS)        MDL16200
C      THETAL = WIND DIRECTION AT BOTTOM AND TOP OF EACH NEW LAYER AFTER        MDL16300
C      TAUL  = TIME IN SECONDS FOR LATERAL CLOUD STABILIZATION IN NEW           MDL16400
C                LAYER STRUCTURE                                                MDL16500
C      TAUOL = TIME IN SECONDS OF SAMPLING PERIOD AT TOP OF NEW LAYER           MDL16600
C      JBOT  = INPUT LAYER NUMBER OF BOTTOM OF NEW LAYER STRUCTURE              MDL16700
C                RELATIVE TO OLD                                                MDL16800
C      JTOP  = INPUT LAYER NUMBER OF TOP OF NEW LAYER STRUCTURE                 MDL16900
C                RELATIVE TO OLD                                                MDL17000
C      VS    = SETTLING VELOCITY IN GRAVITATIONAL DEPOSITION MODEL              MDL17100
C      PERC  = FREQUENCY OF VS                                                  MDL17200
C      ACCUR = DESIRED ACCURACY COEFFICIENT (.45) INSURES THAT GROUND           MDL17300
C                DEPOSITION FROM NACI POINT SOURCES IN THE LAYER VARIES         MDL17400
C                LESS THAN TEN PERCENT FROM DEPOSITION EXPECTED FROM A          MDL17500
C                VERTICAL LINE SOURCE IN THE LAYER. FOR (.32) REDUCED TO        MDL17600
C                FIVE PERCENT                                                   MDL17700
C      VB    = SETTLING VELOCITIES FROM A BURST OR DESTRUCT IN LAYER NNZ        MDL17800
C      PERCB = FREQUENCY OF VB                                                  MDL17900
C      HB    = HEIGHT OF BURST (METERS)                                         MDL18000
C      PPWR  = CALCULATED WIND SPEED POWER LAW EXPONENT                         MDL18100
C      GPWR  = CALCULATED SIGEP POWER LAW EXPONENT                              MDL18200
C      MPWR  = CALCULATED SIGAP POWER LAW EXPONENT                              MDL18300
C      DTHR  = WIND ANGLE SHEAR                                                 MDL18400
C      NVS   = NUMBER OF SETTLING VELOCITIES VS                                 MDL18500
```

```
C     NVB   = NUMBER OF SETTLING VELOCITIES VB                                  MDL18600
C     II    = INDEX ON VS AND VB                                               MDL18700
C     DEP   = TEMP STORAGE                                                     MDL18800
C     YBARY = CALCULATED CORRDINATE OF POINT ON CLOUD AXIS OF VS AT            MDL18900
C             INTERSECTION WITH GROUND  (DEPOSITION)                           MDL19000
C     XBARX = CALCULATED CORRDINATE OF POINT ON CLOUD AXIS OF VS AT            MDL19100
C             INTERSECTION WITH GROUND  (DEPOSITION)                           MDL19200
C     UBARNK = CALCULATED WIND SPEED  (DEPOSITION)                             MDL19300
C     BETANK = CALCULATED BETA   (DEPOSITION)                                  MDL19400
C     ALPHNK = CALCULATED ALPHA  (DEPOSITION)                                  MDL19500
C     SGBAR  = TEMP STORAGE                                                    MDL19600
C     ANG    =  ANGLE  TO POINT XBARX,YBARY  (DEPOSITION)                      MDL19700
C     NACI   = NUMBER OF POINT SOURCES IN LAYER  (DEPOSITION)                  MDL19800
C     DEPN   = CALCULATED VALUE OF GRAVITATIONAL DEPOSITION                    MDL19900
C     SIGYNK = SIGY OF NEW LAYER STRUCTURE IN CALCULATION OF DOSAGE AND        MDL20000
C              CONCENTRATION                                                   MDL20100
C     SIGZNK = CALCULATED SIGEP (DEPOSITION)                                   MDL20200
C     SIGANK = CALCULATED SIGAP (DEPOSITION)                                   MDL20300
C     TIMAV = CONCENTRATION AVERAGING TIME (SECONDS)                           MDL20400
C     AVCON = AVERAGE CONCENTRATION                                            MDL20500
C     PASSTM = TIME OF CLOUD PASSAGE                                           MDL20600
C     AVMXCN = MAXIMUM AVERAGE CONCENTRATION                                   MDL20700
C     XMY   = DISTANCE DOWNWIND FROM THE VIRTUAL POINT SOURCE OVER             MDL20800
C             WHICH RECTILINEAR EXPANSION OCCURS LATERALLY   (METERS)          MDL20900
C     XMZ   = DISTANCE DOWNWIND FROM THE VIRTUAL POINT SOURCE OVER             MDL21000
C             WHICH RECTILINEAR EXPANSION OCCURS VERTICALLY  (METERS)          MDL21100
C     XLRY  = DISTANCE FROM TRUE SOURCE TO POINT OF MEASUREMENT OF             MDL21200
C             SIGYO  (METERS)                                                  MDL21300
C     XLRZ  = DISTANCE FROM TRUE SOURCE TO POINT OF MEASUREMENT OF             MDL21400
C             SIGZO  (METERS)                                                  MDL21500
C     GAMMA  = FRACTION OF MATERIAL REFLECTED AT THE SURFACE (=1 FOR           MDL21600
C              COMPLETE REFLECTION, =0 FOR NO REFLECTION)                      MDL21700
C     GAMMAP = 1.0-GAMMA                                                       MDL21800
C     NAMCAS = SPECIAL CASE IDENTIFICATION INFORMATION                         MDL21900
C     SCL - MAP SCALE FACTOR IN INCHES FOR ISOPLETH PLOTS. IF THE MAP          MDL22000
C           SCALE FACTOR IS 1 INCH = 24000 INCHES THEN SCL WOULD BE            MDL22100
C           INPUT AS 24000. (IF 0 THE PROGRAM WILL CALCULATE SCL)              MDL22200
C     ISW - SWITCH FOR MAXIMUM CENTERLINE PLOTS. IF SET TO 0 OR 2              MDL22300
```

```
C          LOG-LOG SCALING IS USED. IF SET TO 1 LINEAR IS USED.                  MDL22400
C     XMAXJN - MAXIMUM ALONG-WIND DISTANCE FROM THE LAUNCH SITE FOR              MDL22500
C              MAXIMUM CENTERLINE PLOTS (METERS) (IF 0 PROG CALCULATES)          MDL22600
C     XMAXIN - MAXIMUM ALONG-WIND DISTANCE FROM THE LAUNCH SITE FOR              MDL22700
C               ISOPLETHS (METERS) (IF 0 PROGRAM CALCULATES)                    MDL22800
C     YMAXIN - MAXIMUM CROSS-WIND DISTANCE FOR ISOPLETHS (METERS) (IF 0          MDL22900
C              PROGRAM CALCULATES)                                              MDL23000
C     YMAXJN - MAXIMUM NUMBER OF LOG CYCLES FOR THE VERTICAL AXIS OF             MDL23100
C              THE MAXIMUM CENTERLINE PLOTS IF ISW = 0 OR 2. OR. MAXIMUM        MDL23200
C              VALUE OF THE VERTICAL AXIS IF ISW = 1. (IF 0 PROGRAM             MDL23300
C              CALCULATES)                                                      MDL23400
C     TEMPR - VIRTUAL POTENTIAL TEMPERATURE AT EACH LAYER BOUNDARY. THIS         MDL23500
C             ARRAY IS USED TO SEE IF THERE IS A NEGATIVE LAPSE RATE           MDL23600
C             IN THE LAYER. THE PROG CHECKS TO SEE IF THE WIND SPEED           MDL23700
C             SHEAR IS NEGATIVE. IF IT IS AND ALSO THE LAPSE RATE IS           MDL23800
C             NEGATIVE THE PROGRAM USES THE ABSOLUTE VALUE OF THE SPEED        MDL23900
C             SHEAR . IF THE SPEED SHEAR IS NEGATIVE AND THE LAPSE RATE        MDL24000
C             IS POSITIVE OR TEMPR IS NOT INPUT THE PROGRAM USES 0 WIND        MDL24100
C             SPEED SHEAR.                                                     MDL24200
C     TEMPL - VIRTUAL POTENTIAL TEMPERATURE AT EACH LAYER BOUNDARY OF            MDL24300
C             THE NEW LAYER STRUCTURE.                                         MDL24400
C     MASTIN = THE NUMBER OF RASTER COUNTS PER INCH ON THE SC4020 FOR           MDL24500
C              ISOPLETH AND MAXIMUM CENTER LINE PLOTS.                         MDL24600
C     XSIZE = THE NUMBER OF RASTER COUNTS ON THE SC4020 IN THE X OR              MDL24700
C             HORIZONTAL PLOT AXIS (EAST-WEST). FOR ISOPLETHS                  MDL24800
C     YSIZE = THE NUMBER OF RASTER COUNTS ON THE SC4020 IN THE Y OR              MDL24900
C             VERTICAL (NORTH-SOUTH) PLOT AXIS FOR ISOPLETHS                   MDL25000
C     XCIZE = THE NUMBER OF RASTER COUNTS ON THE SC4020 IN THE X OR              MDL25100
C             ALONG-WIND HORIZONTAL AXIS FOR MAXIMUM CENTERLINE PLOTS.         MDL25200
C     YCIZE = THE NUMBER OF RASTER COUNTS ON THE SC4020 IN THE VERTICAL          MDL25300
C             AXIS FOR MAXIMUM CENTERLINE PLOTS                                MDL25400
C     NVMLL = SAME AS NVMCLC                                                   MDL25500
C     METDAT = SAME AS METDTC                                                  MDL25600
C     NSNL = SAME AS NSNLC                                                     MDL25700
C     NMDLL = SAME AS NMDLLC                                                   MDL25800
C     NPLNT = SAME AS NPLNTC                                                   MDL25900
C                                                                              MDL26000
C                                                                              MDL26100
```

```
      C                                                                       MDL26200
      C                                                                       MDL26300
      C                                                                       MDL26400
      C                                                                       MDL26500
            COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI, MDL26600
           1NDK,NPTS,NVS,NVB,AX(41),TY(41),Z(16),DELX(15),DELY(15),G(15),    MDL26700
           2UBARK(16),SIGAK(16),SIGER(16),SIGXO(15),SIGYO(15),SIGZO(15),     MDL26800
           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,    MDL26900
           4XLRY,XLRZ,ZZL(40),IZMUD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10), MDL27000
           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUM,VB(20),PERCB(20),MDL27100
           6MB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)MDL27200
           7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)               MDL27300
            COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),MDL27400
           1DELU(20),VEH,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,STO1,   MDL27500
           2SIO2,STO3,THD,ILK,HAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR, MDL27600
           3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NGD,NTT,   MDL27700
           4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IN1,MDLS,NWD,         MDL27800
           5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),      MDL27900
           6SIGENK(41),SIGANK(41),DEPN(41,41),RN6,AZM,IDATE(2),ITIME(2),YT,  MDL28000
           7NTSS,CDAMX(3)                                                    MDL28100
            DIMENSION CON(1),DOS(1),AVCON(1),PASSTN(1)                       MDL28200
            DIMENSION NUNM(12),DTNM(2)                                       MDL28300
            EQUIVALENCE (CON,DEPN),(DOS,DEPN(1,2)),(AVCON,DEPN(1,3)),(PASSTN,DMDL28400
           1EPN(1,4))                                                        MDL28500
            REAL MPWR,L,LAT,LAMBDA                                           MDL28600
            INTEGER TESTNO                                                   MDL28700
            DATA DTNM/6HPRECIP,6H  GRAV/,NUNM/6H(MG/M,3H**2),6H  (PH),1H ,6H(MMDL28800
           1G/M,3H**3),6H(MGSEC,6H/M**3),6H  (PPM,1H),6H  (PPM,5H SEC)/,NPLNTPMDL28900
           2/6HAL203 /                                                       MDL29000
            DATA ZEROES/0,0/                                                 MDL29100
      C                    *** INPUT SECTION ***                             MDL29200
            SQR2P = 2.5066283                                                MDL29300
            RAD = .01745329                                                  MDL29400
            IFF = 1                                                          MDL29500
            MPR = 0                                                          MDL29600
      C                          READ MODEL PARAMETERS                       MDL29700
          1 CALL READER(IFF)                                                 MDL29800
            IFF = 2                                                          MDL29900
```

```
      IF (KS*(1) .LE. 0) GO TO 5                                                MDL30000
C                     EXECUTE GRAVITATIONAL DEPOSITION MODEL                    MDL30100
      CALL DEPOS                                                                MDL30200
      GO TO 700                                                                 MDL30300
    5 CONTINUE                                                                  MDL30400
      IF (ISKIP(2) .LE. 1.AND.ISKIP(3) .LE. 1) GO TO 6                          MDL30500
      IF (MBR .EQ. 5) GO TO 6                                                   MDL30600
      MBR = 5                                                                   MDL30700
      CALL IDENT(35,'HARD COPY, 1 EACH, PLUS FILE')                             MDL30800
      CALL SETMIV(0,0,0,0)                                                      MDL30900
    6 CONTINUE                                                                  MDL31000
      DO 8 I=1,3                                                                MDL31100
    8 CDAMX(I) = 0.0                                                            MDL31200
      IF (ISKIP(5) .EQ. 1.AND.ISKIP(9) .EQ. 1) CDAMX(1) = 14.0                  MDL31300
      IBK = 1                                                                   MDL31400
      DO 10 J=1,41                                                              MDL31500
      DO 10 I=1,41                                                              MDL31600
   10 DEPN(I,J) = 0.0                                                           MDL31700
   20 CONTINUE                                                                  MDL31800
      KTK = 1                                                                   MDL31900
      K = 1                                                                     MDL32000
      NYSS = NYS                                                                MDL32100
      IMB = 0                                                                   MDL32200
      IPG = 0                                                                   MDL32300
      DO 500 KK=1,NMZ                                                           MDL32400
C                     *** LIST INPUT PARAMETERS ***                             MDL32500
      WRITE (6,903) KK                                                          MDL32600
      WRITE (6,904)                                                             MDL32700
      IF (KK .NE. 1) GO TO 92                                                   MDL32800
      WRITE (6,905) Q(KK),ZRK,UBARK(KK),UBARK(KK+1),SIGAK(KK),SIGAK(KK+1)MDL32900
     1),SIGEK(KK),SIGEK(KK+1),TAUK,TAUOK,SIGXO(KK),SIGYO(KK),SIGZO(KK),  MDL33000
     2THETAK(KK),THETAK(KK+1),Z(KK),ALPHA(KK),BETA(KK),H,DELX(KK),       MDL33100
     3DELY(KK),IZMOD(KK),TIM1,ZLIM,LAMBDA,TIMAV,XRY,XRZ,XLRY,XLRZ        MDL33200
     4,GAMMAP(1)                                                                MDL33300
      GO TO 93                                                                  MDL33400
   92 CONTINUE                                                                  MDL33500
      WRITE (6,918) Q(KK),UBARK(KK),UBARK(KK+1),SIGAK(KK),SIGAK(KK+1),    MDL33600
     1SIGEK(KK),SIGEK(KK+1),SIGXO(KK),SIGYO(KK),SIGZO(KK),THETAK(KK),     MDL33700
```

```
     2THETAK(KK+1),Z(KK),ALPHA(KK),BETA(KK),DELX(KK),DELY(KK),                  MDL33800
     3IMOD(KK)                                                                  MDL33900
  93 IF (KK .NE. NNZ) GO TO 94                                                  MDL34000
     WRITE (6,919) Z(KK+1)                                                      MDL34100
  94 CONTINUE                                                                   MDL34200
     NNZILK = NNZ+ILK                                                           MDL34300
     IF (NBK .EQ. 0.OR.KK .NE. JBOT(ILK)) GO TO 97                              MDL34400
     IF (JBOT(ILK) .NE. 1) GO TO 96                                             MDL34500
     LSP = ILK*2-1                                                              MDL34600
     WRITE (6,920) ZKL,UBARL(LSP),UBARL(LSP+1),SIGAL(LSP),SIGAL(LSP+1),         MDL34700
    1SIGEL(LSP),SIGEL(LSP+1),THETAL(LSP),THETAL(LSP+1),TAUL,TAUOL,              MDL34800
    2ALPHA(NNZILK),BETA(NNZILK),TAST(ILK),JBOT(ILK),JTOP(ILK)                   MDL34900
     GO TO 97                                                                   MDL35000
  96 CONTINUE                                                                   MDL35100
     LSP = ILK*2-1                                                              MDL35200
     WRITE (6,921) UBARL(LSP),UBARL(LSP+1),SIGAL(LSP),SIGAL(LSP+1),             MDL35300
    1SIGEL(LSP),SIGEL(LSP+1),THETAL(LSP),THETAL(LSP+1),TAUL,TAUOL,ALPHAMDL35400
    2(NNZILK),BETA(NNZILK),TAST(ILK),JBOT(ILK),JTOP(ILK)                        MDL35500
  97 CONTINUE                                                                   MDL35600
     WRITE (6,922) UBAR(KK),THETA(KK),DELTHP(KK),DELU(KK),SIGAP(KK),            MDL35700
    1SIGEP(KK)                                                                  MDL35800
     IF (NBK .EQ. 0.OR.KK.NE. JBOT(ILK)) GO TO 98                               MDL35900
     WRITE (6,923) UBAR(NNZILK),THETA(NNZILK),DELTHP(NNZILK),                   MDL36000
    1DELU(NNZILK),SIGAP(NNZILK),SIGEP(NNZILK)                                   MDL36100
  98 CONTINUE                                                                   MDL36200
     CALL TESTR(KTK)                                                            MDL36300
     WRITE (6,917)                                                              MDL36400
C                    *** GENERAL GRID PATTERN CALCULATIONS ***                  MDL36500
 140 CONTINUE                                                                   MDL36600
     JF = NNZ+ILK-1                                                             MDL36700
     IF (KSA(2) .LE. 0) GO TO 145                                               MDL36800
     IF (IFG .EQ. 1) GO TO 500                                                  MDL36900
     GO TO 148                                                                  MDL37000
 145 CONTINUE                                                                   MDL37100
     IF (K .GT. NPTS) GO TO 500                                                 MDL37200
     IF (ZZL(K)-Z(KK+1)) 148,500,500                                            MDL37300
 148 MDLS = MODLS(KK)                                                           MDL37400
     IF (NBK.GT.0.AND.KK.GE.IBOT.AND.KK.LE.ITOP) MDLS = 4                       MDL37500
```

```
      IF (NBK .LE. 0) GO TO 149                                          MDL37600
      IF (KK .LT. IBOT.OR.KK .GT. ITOP) GO TO 149                        MDL37700
      YT = THETA(JF)+180.0                                               MDL37800
      ZBSL = Z(IBOT)                                                     MDL37900
      ZTPL = Z(ITOP+1)                                                   MDL38000
      GO TO 150                                                          MDL38100
  149 YT = THETA(KK)+180.0                                               MDL38200
      ZBSL = Z(KK)                                                       MDL38300
      ZTPL = Z(KK+1)                                                     MDL38400
  150 CONTINUE                                                           MDL38500
C     DEFAULT YT (ANGULAR AXES)                                          MDL38600
      IF (IMB .EQ. 1) GO TO 153                                          MDL38700
      IF (NYS .GT. 0) GO TO 153                                          MDL38800
      DEP = YT                                                           MDL38900
      NYSS = 41                                                          MDL39000
      DO 152 J=1,NYSS                                                    MDL39100
  152 YT(J) = DEP+YSV(J)                                                 MDL39200
  153 CONTINUE                                                           MDL39300
      DO 200 I=1,NXS                                                     MDL39400
      DO 160 J=1,NYSS                                                    MDL39500
      IF (KSW(2) .GT. 0) GO TO 155                                       MDL39600
      CALL BREAK(X,XX(I),YT(J))                                          MDL39700
      CDAMX(1) = AMAX1(CDAMX(1),CON(J))                                  MDL39800
      CDAMX(2) = AMAX1(CDAMX(2),DOS(J))                                  MDL39900
      CDAMX(3) = AMAX1(CDAMX(3),AVCON(J))                                MDL40000
      GO TO 160                                                          MDL40100
  155 CALL BASHT                                                         MDL40200
  160 CONTINUE                                                           MDL40300
      IF (KSW(2) .LE. 0) GO TO 170                                       MDL40400
      IMB = 1                                                            MDL40500
       GO TO 200                                                         MDL40600
  170 CONTINUE                                                           MDL40700
C     OUTPUT GENERAL GRID PATTERN CALCULATIONS                           MDL40800
      KOUT = 401-3                                                       MDL40900
      CALL INTOUT(CON,KOUT,NYSS,2,1,1)                                   MDL41000
      KOUT = 401-2                                                       MDL41100
      CALL INTOUT(DOS,KOUT,NYSS,2,1,1)                                   MDL41200
      KOUT = 401-1                                                       MDL41300
```

```
      CALL INTOUT(AVCON,KOUT,NYSS,2,1,1)                                MDL41400
      KOUT = 400                                                        MDL41500
      CALL INTOUT(PASSTN,KOUT,NYSS,2,1,1)                               MDL41600
  200 CONTINUE                                                          MDL41700
      IF (KSW(2) .LE. 0) GO TO 210                                      MDL41800
      IF (Z(KK+1) .LT. ZLIM) GO TO 500                                  MDL41900
      IFG = 1                                                           MDL42000
C     OUTPUT WASHOUT DEPOSITION PATTERNS                                MDL42100
      DO 205 J=1,NYSS                                                   MDL42200
      DO 205 I=1,NXS                                                    MDL42300
      IF (ISKIP(5) .GT. 1.OR.ISKIP(9) .EQ. 0) GO TO 204                 MDL42400
      IF (DEPN(I,J) .LE. 0.0) GO TO 205                                 MDL42500
      IF (DEPN(I,J) .GT. 1.0) DEPN(I,J) = 1.0                           MDL42600
      IF (DEPN(I,J) .LT. 1.0E-14) DEPN(I,J) = 1.0E-14                   MDL42700
      DEPN(I,J) = -ALOG10(DEPN(I,J))                                    MDL42800
      IF (DEPN(I,J) .LE. 0.0) DEPN(I,J) = 1.0E-20                       MDL42900
      CDAMX(1) = AMIN1(CDAMX(1),DEPN(I,J))                              MDL43000
      GO TO 205                                                         MDL43100
  204 CDAMX(1) = AMAX1(CDAMX(1),DEPN(I,J))                              MDL43200
  205 CONTINUE                                                          MDL43300
      NCLS = 5                                                          MDL43400
      ZCL(1) = Z(1)                                                     MDL43500
      CALL GENPRT(1,ZBSL,ZTPL)                                          MDL43600
      GO TO 500                                                         MDL43700
  210 CONTINUE                                                          MDL43800
      CALL GENPRT(K,ZBSL,ZTPL)                                          MDL43900
      K = K+1                                                           MDL44000
      IF (K .GT. NPTS) GO TO 500                                        MDL44100
      IF (ZZL(K) .LT. Z(KK+1)) GO TO 140                                MDL44200
  500 CONTINUE                                                          MDL44300
C      **** LOOP FOR NEXT TEST *****                                    MDL44400
  700 CONTINUE                                                          MDL44500
      WRITE (9) (ZERO,S,J=1,6)                                          MDL44600
      IF (NPS .EQ. 0) GO TO 1                                           MDL44700
  777 CONTINUE                                                          MDL44800
  800 CONTINUE                                                          MDL44900
C     READ AND WRITE OUT SUMMARY INFO. FOR THIS RUN                     MDL45000
C                                                                       MDL45100
```

```
      LSTMDL = 0                                                        MDL45200
      ENDFILE 9                                                         MDL45300
       REWIND 9                                                         MDL45400
      IRUN = 1                                                          MDL45500
  810 READ (9,END=880) IVHC1,IVHC2,IVHC3,MONTH,NDAY,MYEAR,MHR,NMODL,    MDL45600
     1IPLNT1                                                            MDL45700
      READ (9) SUMH,SUMH6,SUMA24,TIMX                                   MDL45800
      READ (9) (CDAMX(K),K=1,3),RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL             MDL45900
      NUMDL = 1                                                         MDL46000
      IF (CDAMX(3) .GE. 0.0) GO TO 850                                  MDL46100
      IF (CDAMX(3)+6.0) 840,840,815                                     MDL46200
  815 CONTINUE                                                          MDL46300
      NUMDL = 5                                                         MDL46400
      I = 1                                                             MDL46500
      J = 1                                                             MDL46600
      IF (CDAMX(2) .LT. 0.0) J = 3                                      MDL46700
  820 IF (NUMDL .EQ. LSTMDL) GO TO 830                                  MDL46800
      LSTMDL = NUMDL                                                    MDL46900
  829 LINES = 7                                                         MDL47000
      WRITE (6,926) DTNM(1),SUMH(J),SUMA(J+1),DTNM(I),DTNM(I)           MDL47100
  830 LINES = LINES+1                                                   MDL47200
      IF (LINES .GT. 55) GO TO 829                                      MDL47300
      WRITE (6,927) IRUN,IVHC1,IVHC2,IVHC3,MONTH,NDAY,MYEAR,MHR,NMODL,  MDL47400
     1IPLNT1,SUMH,RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL,CDAMX(1)                  MDL47500
  831 READ (9) (CDAMX(K),K=1,3),RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL             MDL47600
      YT = CDAMX(3)+RTOMX+ATOMX+ZTOMX+ZBSL+ZTPL                         MDL47700
      IF (YT) 832,833,832                                               MDL47800
  832 LINES = LINES+1                                                   MDL47900
      IF (LINES .GT. 55) GO TO 829                                      MDL48000
      WRITE (6,929) RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL,CDAMX(1)                MDL48100
      GO TO 831                                                         MDL48200
  833 CONTINUE                                                          MDL48300
      GO TO 870                                                         MDL48400
  840 I = 2                                                             MDL48500
      NUMDL = 6                                                         MDL48600
      J = 1                                                             MDL48700
      GO TO 820                                                         MDL48800
  850 IF (NUMDL .EQ. LSTMDL) GO TO 860                                  MDL48900
```

```
      LSTMDL = NMMDL                                                    MDL49000
      J = 9                                                             MDL49100
      I = 11                                                            MDL49200
      IF (IPLNT1 .NE. NPLNTP) GO TO 855                                 MDL49300
      J = 5                                                             MDL49400
      I = 7                                                             MDL49500
  855 CONTINUE                                                          MDL49600
      TIMX = TIMX/60.0                                                  MDL49700
  857 LINES = 7                                                         MDL49800
      WRITE (6,925) TIMX,NUMM(J),NUMM(J+1),NUMM(I),NUMM(I+1),NUMM(J),   MDL49900
     1NUMM(J+1)                                                         MDL50000
  860 LINES = LINES+1                                                   MDL50100
      IF (LINES .GT. 55) GO TO 857                                      MDL50200
      WRITE (6,926) IRUN,IVHC1,IVHC2,IVHC3,MMNTH,MDAY,MYEAR,MHR,MMODL,  MDL50300
     1IPLNT1,SUMH,RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL,(CDAMX(K),K=1,3)          MDL50400
  861 READ (9) (CDAMX(K),K=1,3),RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL             MDL50500
      YT = CDAMX(1)+CDAMX(2)+CDAMX(3)+RTOMX+ATOMX+ZTOMX+ZBSL+ZTPL       MDL50600
      IF (YT) 862,863,862                                               MDL50700
  862 LINES = LINES+1                                                   MDL50800
      IF (LINES .GT. 52) GO TO 857                                      MDL50900
      WRITE (6,930) RTOMX,ATOMX,ZTOMX,ZBSL,ZTPL,(CDAMX(K),K=1,3)        MDL51000
      GO TO 861                                                         MDL51100
  863 CONTINUE                                                          MDL51200
  870 CONTINUE                                                          MDL51300
      IRUN = IRUN+1                                                     MDL51400
      GO TO 810                                                         MDL51500
  880 CONTINUE                                                          MDL51600
      IF (MBR .EQ. 5) CALL ENDJOB                                       MDL51700
  903 FORMAT (1H0,55X,11H***** LAYER,I2,6H *****)                       MDL51800
  904 FORMAT (1H0,57X,16H** INPUT DATA **)                              MDL51900
  905 FORMAT (4H0 Q=,E14.6,6H, ZHK=,F7.3,17H, UBAR AT BOTTOM=,F8.4,14H, MDL52000
     1UBAR AT TOP=,F8.4,18H, SIGAK AT BOTTOM=,F8.5/14H SIGAK AT TOP=,F8.MDL52100
     25,16H, SIGEK AT BOTTOM=,F8.5,15H, SIGEK AT TOP=,F8.5,7H, TAUK=,F8.MDL52200
     33,6H, TAUOK=,F8.3/7H SIGXO=,F9.4,6H, SIGYO=,F9.4,6H, SIGZO=,F9.4,1MDL52300
     49H, THETAK AT BOTTOM=,F8.3,16H, THETAK AT TOP=,F8.3,4H, Z=,F9.3/7HMDL52400
     5 ALPHA=,F4.1,6H BETA=,F4.1,4H, H=,F9.3,7H, DELX=,E14.8,7H, DELY=,EMDL52500
     614.8,8H, NZMDL=,I3,7H, TIM1=,E14.8/6H ZLIM=,F9.3,                 MDL52600
     79H, LAMBDA=,F7.4,8H, TIMAV=,F8.3,6H, ARY=,F8.3,6H, ARZ=,F8.3,7H, XMDL52700
```


113

```
     BLKY=,F8.3,7H, XLRZ=,F6.3,9H, GAMMAP=,F5.3)                                MDL52800
917  FORMAT (12X,16(6H------)/)                                                 MDL52900
918  FORMAT (4H0 G=,E14.6,17H, UBAR AT BOTTOM=,F6.4,14H, UBAR AT TOP=,FMDL53000
     18.4,16H, SIGAR AT BOTTOM=,F8.5,15H, SIGAR AT TOP=,F8.5/17H SIGER AMDL53100
     2T BOTTOM=,F8.5,15H, SIGER AT TOP=,F8.5,8H, SIGXO=,F9.4,8H, SIGYO=,MDL53200
     3F9.4,8H, SIGZO=,F9.4,19H, THETAR AT BOTTOM=,F8.3/15H THETAR AT TOPMDL53300
     4=,F8.3,4H, Z=,F9.3,8H, ALPHA=,F4.1,7H, BETA=,F4.1,          7H, MDL53400
     5DELA=,E14.8,7H, DELT=,E14.8/7H IZMOD=,I3)                                 MDL53500
919  FORMAT (1X,10H Z AT TOP=,F10.4)                                            MDL53600
920  FORMAT (6H0 ZRL=,F7.3,18H, UBARL AT BOTTOM=,F8.4,15H, UBARL AT TOPMDL53700
     1=,F8.4,18H, SIGAL AT BOTTOM=,F8.5,15H, SIGAL AT TOP=,F8.5/17H SIGEMDL53800
     2L AT BOTTOM=,F8.5,15H, SIGEL AT TOP=,F8.5,19H, THETAL AT BOTTOM=,FMDL53900
     38.3,16H, THETAL AT TOP=,F8.3,7H, TAUL=,F8.3/7H TAUOL=,F8.3,8H, ALPMDL54000
     4HL=,F4.1,7H, BETL=,F4.1,7H, TAST=,E14.8,7H, JBOT=,I2,7H, JTOP=,I2)MDL54100
921  FORMAT (18H0 UBARL AT BOTTOM=,F8.4,15H, UBARL AT TOP=,F8.4,16H, SIMDL54200
     1GAL AT BOTTOM=,F8.5,15H, SIGAL AT TOP=,F8.5/17H SIGEL AT BOTTOM=,FMDL54300
     28.5,15H, SIGEL AT TOP=,F8.5,19H, THETAL AT BOTTOM=,F8.3,16H, THETAMDL54400
     3L AT TOP=,F8.3,7H, TAUL=,F8.3/7H TAUOL=,F8.3,8H, ALPHL=,F4.1,7H, BMDL54500
     4ETL=,F4.1,7H, TAST=,E14.8,7H, JBOT=,I2,7H, JTOP=,I2)                      MDL54600
922  FORMAT (1H0,50HCALCULATED INPUT PARAMETERS FOR MODELS 1,2,3 ****  UMDL54700
     1BAR =,F10.5,9H, THETA =,F10.5,10H, DELTHP =,F10.5,8H, DELU =,F10.5MDL54800
     2/1X,09H, SIGAP =,F10.5,9H, SIGEP =,F10.5)                                 MDL54900
923  FORMAT (1H0,63HCALCULATED INPUT PARAMETERS FOR LAYER CHANGE MODEL MDL55000
     14 *** UBAR =,F10.5,9H, THETA =,F10.5,10H, DELTHP =,F10.5/1X,8H  DEMDL55100
     2LU =,F10.5,9H, SIGAP =,F10.5,9H, SIGEP =,F10.5)                           MDL55200
925  FORMAT (1H1,56X,15HSUMMARY OF RUNS/131H  R       VEHICLE          DAMDL55300
     1TE   TIME  N CONST- CLD RISE RANGE    AZIMUTH   HEIGHT  LAYER    LMDL55400
     2AYER    MAX PEAK       MAX      MAX PEAK/3H  U,20X,098HMO DY YR      MDL55500
     3  C ITUENT  HEIGHT   TO         TO         OF     BOTTOM    TOP      MDL55600
     4 CONC      DOSAGE  ,F5.1,5H MIN./3H  N,28X,8H(HK-Z) D,10X,51H(M)      MDL55700
     5 MAX PEAK MAX PEAK   CALC.    (M)       (M)     ,A6,A3,2A6,10H TIME  MDL55800
     6MEAN/38X,1HE,18X,22HCONC     CONC       (M),46X,4HCONC/38X,1HL,18X,MDL55900
     73H(M),6X,5H(DEG),51X,A6,A3/1X,65(2H--))                                   MDL56000
926  FORMAT (1H1,56X,15HSUMMARY OF RUNS/113H  R       VEHICLE          DAMDL56100
     1TE   TIME  N CONST- CLD RISE   RANGE        AZIMUTH   HEIGHT  LAYERMDL56200
     2    LAYER   MAX PEAK/3H  U,20X,38HMO DY YR        O ITUENT  HEIGHT MDL56300
     3    TO,11X,2HTO,8X,22HOF    BOTTOM    TOP    ,A6,4H DEP/3H  N,28X,8MDL56400
     4H(HK-Z) D,10X,56H(M)     MAX PEAK    MAX PEAK    CALC.   (M)       MDL56500
```

```
      5(M)     ,A6,A3/38X,1HE,16X,A6,6H DLP  ,A6,12H DEP      (M)/38X,1HL 2MDL56600
     60A,3H(M),7X,5H(DEG)/1X,58(2H--))                                    MDL56700
  927 FORMAT (1X,I2,1A,3A6,I3,2(1H/,I2),I5,I3,1X,A6,F8.2,F10.2,F11.2,F12MDL56800
     1.2,2F8.2,F11.3)                                                     MDL56900
  928 FORMAT (1X,I2,1A,3A6,I3,2(1H/,I2),I5,I3,1X,A6,F8.2,F9.2,F8.2,F10.2MDL57000
     1,F8.2,F9.2,3F11.3)                                                  MDL57100
  929 FORMAT (53X,2F11.2,F12.2,2F8.2,F11.3)                               MDL57200
  930 FORMAT (54X,F9.2,F8.2,F10.2,F8.2,F9.2,3F11.3)                       MDL57300
      STOP                                                                MDL57400
      END                                                                 MDL57500
```

TABLE OF CONTENTS

Section		Title	Page No.	
		INTRODUCTION	1	1/A4
A		USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM—VERSION 6	3	1/A6
	A.1	Program Input Parameters	3	1/A6
	A.2	Program Input Data Card Sequence	4	1/A7
	A.3	Preprocessor Program Output	12	1/B1
	A.4	Fortran Source Listing for the NASA/MSFC Cloud-Rise Preprocessor Program —Version 6	12	1/B1
B		USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM — VERSION 6	65	2/B11
	B.1	Program Description	65	2/B11
	B.2	Program Input Parameters	66	2/B12
	B.3	Condensed Table of Namelist Input Parameters	90	2/D8
	B.4	Data Input Format	98	2/E9
	B.5	Fortran Source Listing for the NASA/MSFC Multilayer Diffusion Program —Version 6	99	2/E10

```
1*            SUBROUTINE READER, VERSION  6, REVISION 0
2*
3*            SUBROUTINE READER(IFF)                                                    RDR00100
4*            COMMON /PARAMT/ TESTNO(12),         ISKIP(15),NXS,NYS,NZS,NDI,NCI,        RDR00200
5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),             RDR00300
6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),              RDR00400
7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,             RDR00500
8*           4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),         RDR00600
9*           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),        RDR00700
10*          6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)       RDR00800
11*          7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                         RDR00900
12*           COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),       RDR01000
13*          1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SGR2P,L,TH,I,J,KK,ST01,           RDR01100
14*          2ST02,ST03,TRD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,        RDR01200
15*          3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,           RDR01300
16*          4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                 RDR01400
17*          5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),              RDR01500
18*          6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,          RDR01600
19*          7NYSS,CDAMA(3)                                                            RDR01700
20*     C     THIS SUBROUTINE READS ALL INPUT DATA AND CALCULATES NECESSARY            RDR01800
21*     C     LAYER PARAMETERS                                                         RDR01900
22*           INTEGER TESTNO                                                           RDR02000
23*           REAL MPWR,L,LAMBDA                                                       RDR02100
24*           DIMENSION XSV(41),IZR1(1)                                                RDR02200
25*           COMMON /LOCALS/ BLAMDA,TEMPK(16),TEMPL(10),NSND,METDAT(3),NVHCL,         RDR02300
26*          1NMODL,NPLNT                                                              RDR02400
27*           DIMENSION NTFB(2)                                                        RDR02500
28*           COMMON /PLTSO/ SCL,XMAXIN,YMAXIN,XSIZE,YSIZE,RASTIN,JSW                  RDR02600
29*           COMMON /PLTLLO/ ISW,XMAXJN,YMAXJN,XCIZE,YCIZE                            RDR02700
30*           EQUIVALENCE(NTFB,ITOP)                                                   RDR02800
31*           EQUIVALENCE (IZR1,ISKIP)                                                 RDR02900
32*           DATA YSV/-35.,-30.,-26.,-22.,-18.,-15.,-12.,-10.,-8.,-6.,-5.,-4.,       RDR03000
33*          1-3.,-2.5,-2.,-1.5,-1.,-.75,-.5,-.25,0.,.25,.5,.75,1.,1.5,2.,2.5,         RDR03100
34*          23.,4.,5.,6.,8.,10.,12.,15.,18.,22.,26.,30.,35./                          RDR03200
35*           DATA XSV/25.,100.,200.,400.,600.,800.,1000.,2000.,3000.,4000.,           RDR03300
36*          15000.,6000.,7000.,8000.,9000.,10000.,11000.,12000.,13000.,14000.,        RDR03400
37*          215000.,16000.,17000.,18000.,20000.,22000.,24000.,26000.,28000.,          RDR03500
38*          330000.,32000.,34000.,36000.,38000.,40000.,42000.,44000.,46000.,          RDR03600
```

```
     4500U0.,65000.,60000./                                                    RDR03700
C      MACHINE DEPENDENT STATEMENT ASSUMES SIX BYTES/WORD                      RDR03800
       DATA TESTNO/12*6H      /,NAMCAS/12*6H      /                            RDR03900
C      SR12I =  1.0/SQRT(12.0)                                                 RDR04000
       NAMELIST /NAM2/ TESTNO,ISKIP,NXS,NYS,NZS,NDI,NCI,NPTS,NTI,TI,           RDR04100
      1NVS,NVB,XX,YY,Z,DELX,DELY,G,UBARK,SIGAK,SIGEK,SIGAO,SIGYO,GAMMAP,       RDR04200
      2SIGZO,ALPHA,BETA,ZRK,TIMAV,THETAK,TAUK,TAUOK,H,XRY,XRZ,XLRY,XLRZ,       RDR04300
      3ZZL,IZMOD,DECAY,TIM1,BLAMDA,DI,CI,TAST,ZLIM,HB,PERCB,VB,                RDR04400
      4VS,PERC,ACCUR,ALPHL,BETL,TAUL,TAUOL,ZRL,UBARL,SIGAL,SIGEL,THETAL,       RDR04500
      5NPS,NAMCAS,SCL,XMAXIN,YMAXIN,ISW,XMAXJN,YMAXJN,RASTIN                   RDR04600
      6,XSIZE,YSIZE,XCIZE,YCIZE,TEMPK,TEMPL,JSW                                RDR04700
      7,NVHCL,METDAT,NSND,NMODL,NPLNT                                          RDR04800
       IF (IFF .GT. 1) GO TO 2                                                 RDR04900
C      ZERO OUT INPUT LISTS FOR PROCESSORS WHERE CORE IS NOT                   RDR05000
C      INITIALIZE TO ZERO, 608 IS THE LENGTH OF COMMON /PARAMT/, SUBTRACT      RDR05100
C      12 FOR TESTNO AND 12 FOR NAMCAS                                         RDR05200
       DO 1 I=1,584                                                            RDR05300
     1 IZR1(I) = 0                                                             RDR05400
     2 CONTINUE                                                                RDR05500
       CALL TAPEIN(IFF)                                                        RDR05600
       IF (IFF .NE. 0) GO TO 3                                                 RDR05700
       RETURN                                                                  RDR05800
     3 CONTINUE                                                                RDR05900
       DO 71 I=1,20                                                            RDR06000
    71 GAMMA(I) = 1.0-GAMMAP(I)                                                RDR06100
       NNZ = NZS-1                                                             RDR06200
       LAMBDA = BLAMDA                                                         RDR06300
       NCC = NCI/10                                                            RDR06400
       NDD = NDI/10                                                            RDR06500
       NTT = NTI/10                                                            RDR06600
       NCCC = NCI-NCC*10                                                       RDR06700
       NDDD = NDI-NDD*10                                                       RDR06800
       NTTT = NTI-NTT*10                                                       RDR06900
       IF (XSIZE .LE. 0.0) XSIZE = 5.5                                         RDR07000
       IF (YSIZE .LE. 0.0) YSIZE = 5.5                                         RDR07100
       IF (XCIZE .LE. 0.0) XCIZE = 5.5                                         RDR07200
       IF (YCIZE .LE. 0.0) YCIZE = 5.5                                         RDR07300
       IF (ISW .LE. 0) ISW = 2                                                 RDR07400
```

```
77*      CC                                                              RDR07500
78*            RASTIN = 1.0                                              RDR07600
79*      CC    IF (RASTIN .LE. 0.0) RASTIN = 163.2                       RDR07700
80*      CC    XSIZE = 957.0                                             RDR07800
81*      CC    YSIZE = 899.0                                             RDR07900
82*      CC    XCIZE = 957.0                                             RDR08000
83*      CC    YCIZE = 899.0                                             RDR08100
84*            IF (NXS .GT. 0) GO TO 5                                   RDR08200
85*      C     DEFAULT XA                                                RDR08300
86*            NXS = 41                                                  RDR08400
87*            DO 4 I=1,NXS                                              RDR08500
88*          4 XA(I) = XSV(I)                                            RDR08600
89*          5 CONTINUE                                                  RDR08700
90*            IF (TAUOK .GT. 0.0) GO TO 6                               RDR08800
91*      C     DEFAULT TAUOK                                             RDR08900
92*            TAUOK = 600.0                                             RDR09000
93*          6 CONTINUE                                                  RDR09100
94*          8 DO 16 I=1,NNZ                                             RDR09200
95*      C     DEFAULT SIGYO                                             RDR09300
96*            IF (SIGYO(I) .GT. 0.0) GO TO 9                            RDR09400
97*            SIGYO(I) = SIGXO(I)                                       RDR09500
98*          9 CONTINUE                                                  RDR09600
99*            IF (ALPHA(I) .GT. 0.0) GO TO 10                           RDR09700
100*     C     DEFAULT ALPHA                                             RDR09800
101*           ALPHA(I) = 1.0                                            RDR09900
102*        10 IF (BETA(I) .GT. 0.0) GO TO 12                            RDR10000
103*     C     DEFAULT BETA                                              RDR10100
104*           BETA(I) = 1.0                                             RDR10200
105*        12 CONTINUE                                                  RDR10300
106*           IF (IZMOD(I) .GT. 0) GO TO 16                             RDR10400
107*     C     DEFAULT IZMOD                                             RDR10500
108*           IZMOD(I) = 1                                              RDR10600
109*        16 CONTINUE                                                  RDR10700
110*           IF (XRY .GT. 0.0) GO TO 18                                RDR10800
111*     C     DEFAULT XRY                                               RDR10900
112*           XRY = 100.0                                               RDR11000
113*        18 IF (XRZ .GT. 0.0) GO TO 20                                RDR11100
114*     C     DEFAULT XRZ                                               RDR11200
```

```
*115*           XNZ = 100.0                                                    RDR11300
*116*        20 IF (TIMAV .GT. 0.0) GO TO 24                                   RDR11400
*117*     C     DEFAULT TIMAV                                                  RDR11500
*118*           TIMAV = 600.0                                                  RDR11600
*119*           IF (ISKIP(5) .EQ. 2) TIMAV = 360.0                             RDR11700
*120*        24 IF (ZRK .GT. 0.0) GO TO 26                                     RDR11800
*121*     C     DEFAULT ZRK                                                    RDR11900
*122*           ZRK = 2.0                                                      RDR12000
*123*        26 CONTINUE                                                       RDR12100
*124*           IF (ISKIP(6) .EQ. 0) ISKIP(6) = 2                              RDR12200
*125*     C     CHECK IZMOD                                                    RDR12300
*126*           KSW(2) = 0                                                     RDR12400
*127*           NOK = 0                                                        RDR12500
*128*           KSW(1) = 0                                                     RDR12600
*129*           DO 75 I=1,5                                                    RDR12700
*130*           JOOT(I) = 0                                                    RDR12800
*131*        75 JTOP(I) = 0                                                    RDR12900
*132*           DO 34 I=1,NNZ                                                  RDR13000
*133*           I1 = IZMOD(I)/100                                              RDR13100
*134*           I2 = (IZMOD(I)-I1*100)/10                                      RDR13200
*135*           I3 = IZMOD(I)-I1*100-I2*10                                     RDR13300
*136*           IF (I .GT. 1) GO TO 27                                         RDR13400
*137*           IF (I1 .NE. 6.AND.I2 .NE. 6.AND.I3 .NE. 6) GO TO 27            RDR13500
*138*           KSW(1) = 1                                                     RDR13600
*139*           GO TO 72                                                       RDR13700
*140*        27 IF (I1.NE.5.AND.I2.NE.5.AND.I3.NE.5) GO TO 28                  RDR13800
*141*           ZLIM = Z(I+1)                                                  RDR13900
*142*           KSW(2) = 1                                                     RDR14000
*143*           I1 = I                                                         RDR14100
*144*        28 IF (I2.EQ.9.OR.I1.EQ.9.OR.I3 .EQ. 9) GO TO 29                  RDR14200
*145*           IF (I2.NE.4.AND.I1.NE.4.AND.I3 .NE. 4) GO TO 31                RDR14300
*146*           IF (NOK .GT. 0) GO TO 30                                       RDR14400
*147*        29 NOK = NOK+1                                                    RDR14500
*148*           JOOT(NOK) = I                                                  RDR14600
*149*        30 JTOP(NOK) = I                                                  RDR14700
*150*        31 NTAL = 0                                                       RDR14800
*151*           MODLS(I) = 1                                                   RDR14900
*152*        32 NTAL = NTAL+1                                                  RDR15000
```


119

```
153*            IF (NTAL .GT. 3) GO TO 33                                          RDR15100
154*            IF (I1 .EQ. NTAL.OR.I2 .EQ. NTAL.OR.I3 .EQ. NTAL) GO TO 33         RDR15200
155*            GO TO 32                                                           RDR15300
156*         33 IF (NTAL .LT. 4) NODLS(I) = NTAL                                   RDR15400
157*         34 CONTINUE                                                           RDR15500
158*            IF (KSW(2) .NE. 1) GO TO 72                                        RDR15600
159*            NPTS = II                                                          RDR15700
160*            DO 70 I=1,II                                                       RDR15800
161*         70 ZZL(I) = Z(I)                                                      RDR15900
162*            GO TO 73                                                           RDR16000
163*         72 IF (NPTS .GT. 0) GO TO 73                                          RDR16100
164*            NPTS = 1                                                           RDR16200
165*            ZZL(1) = 0.0                                                       RDR16300
166*         73 CONTINUE                                                           RDR16400
167*            IF (LAMBDA .LE. 0.0) GO TO 74                                      RDR16500
168*            IF (ZLIM .LE. 0.0) ZLIM = Z(NZS)                                   RDR16600
169*         74 CONTINUE                                                           RDR16700
170*            DO 36 I=1,NZS                                                      RDR16800
171*      C     CHECK MINIMUM LIMITS                                               RDR16900
172*            IF (SIGAK(I) .LT. .5) SIGAK(I) = .5                                RDR17000
173*            IF (SIGEK(I) .LT. .1) SIGEK(I) = .1                                RDR17100
174*            IF (UBARK(I) .LT. .1) UBARK(I) = .1                                RDR17200
175*         36 CONTINUE                                                           RDR17300
176*            IF (NBK .EQ. 0) GO TO 57                                           RDR17400
177*            IF (ISKIP(7) .GT. 0) GO TO 40                                      RDR17500
178*      C     DETERMINE LAYER CHANGE PARAMETERS                                  RDR17600
179*            ZKL = ZRK                                                          RDR17700
180*            II = -1                                                            RDR17800
181*            DO 38 I=1,NBK                                                      RDR17900
182*            II = II+2                                                          RDR18000
183*            NTAL = JBOT(I)                                                     RDR18100
184*            NTAK = JTOP(I)                                                     RDR18200
185*            UBARL(II) = UBARK(NTAL)                                            RDR18300
186*            UBARL(II+1) = UBARK(NTAK+1)                                        RDR18400
187*            SIGAL(II) = SIGAK(NTAL)                                            RDR18500
188*            SIGAL(II+1) = SIGAK(NTAK+1)                                        RDR18600
189*            SIGEL(II) = SIGEK(NTAL)                                            RDR18700
190*            SIGEL(II+1) = SIGEK(NTAK+1)                                        RDR18800
```

```
      THETAL(II) = THETAK(NTAL)                                          RDR18900
      THETAL(II+1) = THETAK(NTAK+1)                                      RDR19000
      ALPHL(I) = ALPHA(NTAL)                                             RDR19100
      BETL(I) = BETA(NTAL)                                               RDR19200
      TEMPL(II) = TEMPK(NTAL)                                            RDR19300
      TEMPL(II+1) = TEMPK(NTAK+1)                                        RDR19400
   38 CONTINUE                                                           RDR19500
      TAUOL = TAUOK                                                      RDR19600
      TAUL = TAUK                                                        RDR19700
      GO TO 52                                                           RDR19800
   40 CONTINUE                                                           RDR19900
      IF (TAUOL .GT. 0.0) GO TO 42                                       RDR20000
C     DEFAULT TAUOL                                                      RDR20100
      TAUOL = 600.0                                                      RDR20200
   42 IF (ZRL .GT. 0.0) GO TO 44                                         RDR20300
C     DEFAULT ZRL                                                        RDR20400
      ZRL = ZRK                                                          RDR20500
   44 DO 48 I=1,NBK                                                      RDR20600
      IF (ALPHL(I) .GT. 0.0) GO TO 46                                    RDR20700
C     DEFAULT ALPHL                                                      RDR20800
      ALPHL(I) = 1.0                                                     RDR20900
   46 IF (BETL(I) .GT. 0.0) GO TO 48                                     RDR21000
C     DEFAULT BETL                                                       RDR21100
      BETL(I) = 1.0                                                      RDR21200
   48 CONTINUE                                                           RDR21300
      NTAL = 2*NBK                                                       RDR21400
      DO 50 I=1,NTAL                                                     RDR21500
C     CHECK MINIMUM VALUES                                               RDR21600
      IF (SIGAL(I) .LT. .5) SIGAL(I) = .5                                RDR21700
      IF (UBARL(I) .LT. .1) UBARL(I) = .1                                RDR21800
      IF (SIGEL(I) .LT. .1) SIGEL(I) = .1                                RDR21900
   50 CONTINUE                                                           RDR22000
   52 NTAK = NNZ+1                                                       RDR22100
      NTAL = NNZ+NBK                                                     RDR22200
C     COMBINE ALPHA AND BETA WITH ALPHL AND BETL                         RDR22300
      DO 54 I=NTAK,NTAL                                                  RDR22400
      INNZ = I-NNZ                                                       RDR22500
      ALPHA(I) = ALPHL(INNZ)                                             RDR22600
```


121

```
229*            BETA(I) = BETL(INNZ)                                                    RDR22700
230*         54 CONTINUE                                                                RDR22800
231*         57 CONTINUE                                                                RDR22900
232*         58 CONTINUE                                                                RDR23000
233*            ST01 = (TAUK/TAU0K)**(0.2)*RAD                                          RDR23100
234*            S = (Z(2)/ZRK)                                                          RDR23200
235*            S1 = 1.0/ALOG(S)                                                        RDR23300
236*            P = RBB(UBARK(2),UBARK(1),S1)                                           RDR23400
237*      C     CALCULATE UBAR FOR LAYER 1                                              RDR23500
238*            UBAR(1) = RB11(UBARK(1),P,Z(2),ZRK)                                     RDR23600
239*            PPWR = P                                                                RDR23700
240*            IF (NNZ .LT. 2) GO TO 152                                               RDR23800
241*            DO 150 I=2,NNZ                                                          RDR23900
242*      C     CALCULATE UBAR FOR LAYERS 2 TO NNZ                                      RDR24000
243*        150 UBAR(I) = 0.5*(UBARK(I+1)+UBARK(I))                                     RDR24100
244*        152 P = RBB(SIGAK(2),SIGAK(1),S1)                                           RDR24200
245*      C     CALCULATE SIGAP FOR LAYER 1                                             RDR24300
246*            SIGAP(1) = ST01*RB11(SIGAK(1),P,Z(2),ZRK)                               RDR24400
247*            MPWR = P                                                                RDR24500
248*            IF (NNZ .LT. 2) GO TO 162                                               RDR24600
249*            ST02 = RAD*(TAUK/600.0)**.2                                             RDR24700
250*            DO 160 I=2,NNZ                                                          RDR24800
251*      C     CALCULATE SIGAP FOR LAYERS 2 TO NNZ                                     RDR24900
252*        160 SIGAP(I) = 0.5*ST02*(SIGAK(I+1)+SIGAK(I))                               RDR25000
253*        162 P = RBB(SIGEK(2),SIGEK(1),S1)                                           RDR25100
254*      C     CALCULATE SIGEP FOR LAYER 1                                             RDR25200
255*            SIGEP(1) = RB11(SIGEK(1),P,Z(2),ZRK)*RAD                                RDR25300
256*            IF (NNZ .LT. 2) GO TO 172                                               RDR25400
257*            QPWR = P                                                                RDR25500
258*            DO 170 I=2,NNZ                                                          RDR25600
259*      C     CALCULATE SIGEP FOR LAYERS 2 TO NNZ                                     RDR25700
260*        170 SIGEP(I) = ((SIGEK(I+1)+SIGEK(I))*RAD)*0.5                              RDR25800
261*        172 DO 180 I=1,NNZ                                                          RDR25900
262*            J = I                                                                   RDR26000
263*      C     CALCULATE THETA FOR ALL LAYERS                                          RDR26100
264*            THETA(I) = 0.5*(THETAK(J+1)+THETAK(J))                                  RDR26200
265*            IF (ABS(THETAK(J+1)-THETAK(J)) .GT. 180.0) THETA(I) = THETA(I)-         RDR26300
266*           1180.0                                                                   RDR26400
```

```
C     CALCULATE DELTHP FOR ALL LAYERS                                    RDR26500
      DELTHP(I) = THETAK(J+1)-THETAK(J)                                  RDR26600
      IF (DELTHP(I) .GT. 180.0) DELTHP(I) = 360.0-DELTHP(I)              RDR26700
      IF (DELTHP(I) .LT. -180.0) DELTHP(I) = 360.0+DELTHP(I)             RDR26800
  180 CONTINUE                                                           RDR26900
      DO 185 I=1,NNZ                                                     RDR27000
C     CALCULATE DELU FOR ALL LAYERS                                      RDR27100
      DELU(I) = UBARK(I+1)-UBARK(I)                                      RDR27200
      IF (DELU(I) .GE. 0.0) GO TO 185                                    RDR27300
      IF (TEMPK(I+1)-TEMPK(I) .GE. 0.0) GO TO 185                        RDR27400
      DELU(I) = ABS(DELU(I))                                             RDR27500
  185 CONTINUE                                                           RDR27600
      IF (KSW(1) .GT. 0) GO TO 250                                       RDR27700
      IF (NBK .EQ. 0) GO TO 250                                          RDR27800
      STOL = (TAUL/TAUOL)**(0.2)*RAD                                     RDR27900
      M = JTOP(1)                                                        RDR28000
      IF (JBOT(1) .GT. 1) GO TO 186                                      RDR28100
      S = (Z(M+1)/ZRL)                                                   RDR28200
      S1 = 1.0/ALOG(S)                                                   RDR28300
  186 IF (ISKIP(7) .GT. 0) GO TO 192                                     RDR28400
      DO 188 I=1,NBK                                                     RDR28500
      NNZ1 = NNZ+1                                                       RDR28600
      M1 = JBOT(I)                                                       RDR28700
      M2 = JTOP(I)                                                       RDR28800
      S = 0.0                                                            RDR28900
      DO 187 J=M1,M2                                                     RDR29000
  187 S = S+0.5*(UBARK(J)+UBARK(J+1))*(Z(J+1)-Z(J))                      RDR29100
      UBAR(NNZI) = S/(Z(M2+1)-Z(M1))                                     RDR29200
  188 CONTINUE                                                           RDR29300
      GO TO 202                                                          RDR29400
  192 CONTINUE                                                           RDR29500
      IF (JBOT(1) .GT. 1) GO TO 193                                      RDR29600
      P = RBB(UBARL(2),UBARL(1),S1)                                      RDR29700
C     CALCULATE UBAR FOR NEW LAYER 1 (IF CONTAINS SURFACE)               RDR29800
      UBAR(NNZ+1) = RB11(UBARL(1),P,Z(M+1),ZRL)                          RDR29900
      GPAR = P                                                           RDR30000
      GO TO 197                                                          RDR30100
C     CALCULATE UBAR FOR NEW LAYER 1 (IF DOES NOT CONTAIN SURFACE)       RDR30200
```

```
305*          193 UBAR(NNZ+1) = (UBARL(1)+UBARL(2))*0.5                    RDR30300
306*          197 IF (NBK .LT. 2) GO TO 202                                RDR30400
307*              DO 200 I=2,NBK                                           RDR30500
308*              J = I*2-1                                                RDR30600
309*      C       CALCULATE UBAR FOR NEW LAYERS 2 TO NBK                   RDR30700
310*              NNZI = NNZ+I                                             RDR30800
311*          200 UBAR(NNZI) = (UBARL(J+1)+UBARL(J))*0.5                   RDR30900
312*          202 IF (JBOT(1) .GT. 1) GO TO 210                            RDR31000
313*              P = RBB(SIGEL(2),SIGEL(1),S1)                            RDR31100
314*      C       CALCULATE SIGEP FOR NEW LAYER 1 (IF CONTAINS SURFACE)    RDR31200
315*              SIGEP(NNZ+1) = RB11(SIGEL(1),P,Z(M+1),ZRL)*RAD           RDR31300
316*              GO TO 215                                                RDR31400
317*      C       CALCULATE SIGEP FOR NEW LAYER 1 (IF DOES'NT CONTAIN SURFACE) RDR31500
318*          210 SIGEP(NNZ+1) = ((SIGEL(2)+SIGEL(1))*RAD)*0.5             RDR31600
319*          215 IF (NBK .LT. 2) GO TO 217                                RDR31700
320*              DO 216 I=2,NBK                                           RDR31800
321*              J = I*2-1                                                RDR31900
322*      C       CALCULATE SIGEP FOR NEW LAYERS 2 TO NBK                  RDR32000
323*              NNZI = NNZ+I                                             RDR32100
324*          216 SIGEP(NNZI) = ((SIGEL(J+1)+SIGEL(J))*RAD)*0.5            RDR32200
325*          217 IF (ISKIP(7) .GT. 0) GO TO 226                           RDR32300
326*              DO 225 I=1,NBK                                           RDR32400
327*      C       CALCULATE THETA FOR NEW LAYERS 1 TO NBK                  RDR32500
328*              NNZI = NNZ+I                                             RDR32600
329*              M1 = JBOT(I)                                             RDR32700
330*              M2 = JTOP(I)                                             RDR32800
331*              T1 = THETAK(M1)                                          RDR32900
332*              ANG(M1) = T1                                             RDR33000
333*              S = 0.0                                                  RDR33100
334*              DO 222 J=M1,M2                                           RDR33200
335*              T2 = THETAK(J+1)                                         RDR33300
336*              IF (ABS(T2-T1) .LE. 180.0) GO TO 221                     RDR33400
337*              IF (T2 .GT. T1) GO TO 220                                RDR33500
338*              T2 = T2+360.0                                            RDR33600
339*              GO TO 221                                                RDR33700
340*          220 T2 = T2-360.0                                            RDR33800
341*          221 P = 0.5*(T2+T1)                                          RDR33900
342*              T1 = T2                                                  RDR34000
```

```
343*          ANG(J+1) = T1                                                    RDR34100
344*      222 S = S+P*(Z(J+1)-Z(J))                                            RDR34200
345*          THETA(NNZI) = S/(Z(M2+1)-Z(M1))                                  RDR34300
346*          T1 = 0.0                                                         RDR34400
347*          T2 = 0.0                                                         RDR34500
348*          M2 = M2+1                                                        RDR34600
349*          DO 223 J=M1,M2                                                   RDR34700
350*          T1 = T1+Z(J)                                                     RDR34800
351*      223 T2 = T2+ANG(J)                                                   RDR34900
352*          P = 1.0/FLOAT(M2-M1+1)                                           RDR35000
353*          T2 = T2*P                                                        RDR35100
354*          T1 = T1*P                                                        RDR35200
355*          P = 0.0                                                          RDR35300
356*          S = 0.0                                                          RDR35400
357*          DO 224 J=M1,M2                                                   RDR35500
358*          P = P+(Z(J)-T1)*(ANG(J)-T2)                                      RDR35600
359*      224 S = S+(Z(J)-T1)**2                                               RDR35700
360*          DELTHP(NNZI) = (Z(M2)-Z(M1))*P/S                                 RDR35800
361*          IF (DELTHP(NNZI) .GT. 180.0) DELTHP(NNZI) = 360.0-DELTHP(NNZI)   RDR35900
362*          IF (DELTHP(NNZI) .LT. -180.0) DELTHP(NNZI) = 360.0+DELTHP(NNZI)  RDR36000
363*      225 CONTINUE                                                         RDR36100
364*          GO TO 230                                                        RDR36200
365*      226 DO 227 I=1,NBK                                                   RDR36300
366*          J = 2*I-1                                                        RDR36400
367*          NNZI = NNZ+1                                                     RDR36500
368*          THETA(NNZI) = 0.5*(THETAL(J+1)+THETAL(J))                        RDR36600
369*          IF(ABS(THETAL(J+1)-THETAL(J)).GT.180.)THETA(NNZI)=THETA(NNZI)+180.RDR36700
370*          DELTHP(NNZI) = THETAL(J+1)-THETAL(J)                             RDR36800
371*          IF (DELTHP(NNZI) .GT. 180.0) DELTHP(NNZI) = 360.0-DELTHP(NNZI)   RDR36900
372*          IF (DELTHP(NNZI) .LT. -180.0) DELTHP(NNZI) = 360.0+DELTHP(NNZI)  RDR37000
373*      227 CONTINUE                                                         RDR37100
374*      230 CONTINUE                                                         RDR37200
375*          DO 235 I=1,NBK                                                   RDR37300
376*          J = I*2-1                                                        RDR37400
377*          NNZI = NNZ+1                                                     RDR37500
378*          IF (ISKIP(7) .NE. 0) GO TO 233                                   RDR37600
379*          M1 = JBOT(I)                                                     RDR37700
380*          M2 = JTOP(I)                                                     RDR37800
```

```
      T1 = 0.0                                                          RDR37900
      T2 = 0.0                                                          RDR38000
      DO 231 J=M1,M2                                                    RDR38100
      T1 = T1+UBARR(J)                                                  RDR38200
  231 T2 = T2+Z(J)                                                      RDR38300
      P = 1.0/FLOAT(M2-M1+1)                                            RDR38400
      T1 = T1*P                                                         RDR38500
      T2 = T2*P                                                         RDR38600
      P = 0.0                                                           RDR38700
      S = 0.0                                                           RDR38800
      DO 232 J=M1,M2                                                    RDR38900
      P = P+(Z(J)-T2)*(UBARR(J)-T1)                                     RDR39000
  232 S = S+(Z(J)-T2)**2                                                RDR39100
      DELU(NNZI) = (Z(M2)-Z(M1))*P/S                                    RDR39200
      GO TO 234                                                         RDR39300
  233 CONTINUE                                                          RDR39400
      DELU(NNZI) = UBARL(J+1)-UBARL(J)                                  RDR39500
  234 CONTINUE                                                          RDR39600
      IF (DELU(NNZI) .GE. 0.0) GO TO 235                                RDR39700
      IF (TEMPL(J+1)-TEMPL(J) .GT. 0.0) GO TO 235                       RDR39800
      DELU(NNZI) = ABS(DELU(NNZI))                                      RDR39900
  235 CONTINUE                                                          RDR40000
  237 IF (JBOT(1) .GT. 1) GO TO 242                                     RDR40100
      P = RBB(SIGAL(2),SIGAL(1),S1)                                     RDR40200
C     CALCULATE SIGAP FOR NEW LAYER 1 (IF CONTAINS SURFACE)             RDR40300
      SIGAP(NNZ+1) = ST01*RB11(SIGAL(1),P,Z(M+1),ZRL)                   RDR40400
      GO TO 243                                                         RDR40500
C     CALCULATE SIGAP FOR NEW LAYER 1 (IF DOES'NT CONTAIN SURFACE)      RDR40600
  242 ST01 = RAD*(TAUL/600.0)**.2                                       RDR40700
      SIGAP(NNZ+1) = 0.5*ST01*(SIGAL(1)+SIGAL(2))                       RDR40800
  243 CONTINUE                                                          RDR40900
      IF (NBK .LT. 2) GO TO 250                                         RDR41000
      IF (JBOT(1) .EQ. 1) ST01 = (TAUL/600.0)**.2*RAD                   RDR41100
      DO 245 I=2,NBK                                                    RDR41200
      J = I*2-1                                                         RDR41300
C     CALCULATE SIGAP FOR NEW LAYERS 2 TO NBK                           RDR41400
      NNZI = NNZ+I                                                      RDR41500
  245 SIGAP(NNZI) = 0.5*ST01*(SIGAL(J+1)+SIGAL(J))                      RDR41600
```

```
      250 CONTINUE                                                          RDR41700
          DO 395 I=2,NZS                                                    RDR41800
          IF (H .LE. Z(I)) GO TO 396                                        RDR41900
      395 CONTINUE                                                          RDR42000
      396 RNG = DELA(I-1)                                                   RDR42100
          AZM = DELT(I-1)                                                   RDR42200
CCC   GET DATE AND TIME (UNIVAC 1106 ONLY)                                  RDR42300
          CALL ENTRAN(9,NTFB(1),NTFB(2))                                    RDR42400
C     LOAD MM/DD/YY INTO IDATE(1) AND (2) ON FIRST LOOP                     RDR42500
C     LOAD HR:MN:SC INTO ITIME(1) AND (2) ON SECOND LOOP                    RDR42600
          N = '/'                                                           RDR42700
          DO 400 I=1,2                                                      RDR42800
          J = 2*I-1                                                         RDR42900
          CALL MSFLD(0,12,NTFB(1),0,IDATE(J))                               RDR43000
          CALL MSFLD(0,0,N,12,IDATE(J))                                     RDR43100
          CALL MSFLD(12,12,NTFB(I),16,IDATE(J))                             RDR43200
          CALL MSFLD(0,0,N,30,IDATE(J))                                     RDR43300
          CALL MSFLD(24,12,NTFB(I),0,IDATE(J+1))                            RDR43400
      400 CONTINUE                                                          RDR43500
CCC   END DATE AND TIME - PRINT WITH A6,A2 FORMAT                           RDR43600
          WRITE (6,1000) NAMCAS,(TESTNO(I),I=1,6),IDATE,ITIME,H,RNG,AZM     RDR43700
C                                                                           RDR43800
C  SAVE INFO FOR END OF RUN SUMMARY                                         RDR43900
          WRITE (9) H,RNG,AZM,TAMAV                                         RDR44000
          IF (ISKIP(8) .EQ. 1) WRITE (6,NAM2)                               RDR44100
          RETURN                                                            RDR44200
 1000 FORMAT (1H1,11(/),24X,21(4H****)/24X,1H*,82X,1H*/24X,1H*,5X,12A6,5RDR44300
     1X,1H*/24X,1H*,82X,1H*/24X,1H*,23X,6A6,23X,1H*/24X,1H*,82X,1H*/     RDR44400
     1                                24X,1H*,25X,7HDATE = ,A6,A2,9H, TIME = ,RDR44500
     2A6,A2,25X,1H*,3(/24X,1H*,62X,1H*)/24X,30H* ADJUSTED CLOUD RISE HEIRDR44600
     3GHT =,F8.2,9H, RANGE =,F9.2,19H, AZIMUTH BEARING =,F7.2,2H *)/24X,1RDR44700
     4H*,62X,1H*/24X,21(4H****)/1H1)                                      RDR44800
          END                                                               RDR44900
```

```
      SUBROUTINE TAPEIN, VERSION 6,  REVISION 0

      SUBROUTINE TAPEIN (IFF)                                                TPN00100
      COMMON/PARAMT/ TESTNO(12),ISKIP(15),NXS,NYS,NZS,NDI,NCI,               TPN00200
     1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),G(15),          TPN00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),           TPN00400
     3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,          TPN00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),      TPN00600
     5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),     TPN00700
     6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)     TPN00800
     7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                       TPN00900
      COMMON /LOCALS/ BLAMDA,TEMPK(16),TEMPL(10),NSND,METDAT(3),NVHCL,       TPN01000
     1NMODL,NPLNT                                                            TPN01100
      DIMENSION METDTC(3)                                                    TPN01200
      COMMON/PLTLLO/ ISW,XMAXJN,YMAXJN,XCIZE,YCIZE                           TPN01300
      COMMON/PLTISO/ SCL,XMAXIN,YMAXIN,XSIZE,YSIZE,RASTIN,JSW                TPN01400
      DIMENSION IVHCT(3,5),IPLNT(4)                                          TPN01500
      DATA IVHCT/6HTITAN ,6HIII C ,6H       ,                                TPN01600
     1 6HSPACE ,6HSHUTTL,6HE       ,                                        TPN01700
     2 6HDELTA-,6HTHOR 2,6H914    ,                                         TPN01800
     3 6HMINUTE,6HMAN II,6H       ,                                         TPN01900
     4 6HDELTA-,6HTHOR 3,6H914    /                                         TPN02000
      DATA IPLNT/6HHCL    ,6HCO     ,6HCO2    ,6HAL2O3 /                   TPN02100
      DIMENSION ICARD(14)                                                    TPN02200
      NAMELIST/NAM2/ TESTNO,ISKIP,NXS,NYS,NZS,NDI,NCI,NPTS,NTI,TI,           TPN02300
     1NVS,NVB,XX,YY,Z,DELX,DELY,G,UBARK,SIGAK,SIGEK,SIGXO,SIGYO,GAMMAP,      TPN02400
     3SIGZO,ALPHA,BETA,ZRK,TIMAV,THETAK,TAUK,TAUOK,H,XRY,XRZ,XLRY,XLRZ,      TPN02500
     3ZZL,IZMOD,DECAY,TIM1,BLAMDA,DI,CI,TAST,ZLIM,HB,PERCB,VB,               TPN02600
     4VS,PERC,ACCUR,ALPHL,BETL,TAUL,TAUOL,ZRL,UBARL,SIGAL,SIGEL,THETAL,      TPN02700
     5NPS,NAMCAS,SCL,XMAXIN,YMAXIN,ISW,XMAXJN,YMAXJN,RASTIN                  TPN02800
     6,XSIZE,YSIZE,XCIZE,YCIZE,TEMPK,TEMPL,JSW                               TPN02900
     7,NVHCL,METDAT,NSND,NMODL,NPLNT                                         TPN03000
C     NVHCLC - VEHICLE NUMBER 1=TITAN,2=SHUTTLE,3=DELTA-THOR 2914,           TPN03100
C              4=MINUTEMAN II,5=DELTA-THOR 3914 (I1 FORMAT COL 1)            TPN03200
C     METDTC - MET DATE MO,DY,YR, (3I2 FORMAT COL 2-7)                       TPN03300
C     NSNDC - SOUNDING NUMBER (I2 FORMAT COL 8-9)                            TPN03400
C     NMOLDC - MODEL NUMBER (I3 FORMAT COL 10-12)                            TPN03500
C     NPLNTC - POLLUTANT NUMBER 1=HCL,2=CO,3=CO2,4=AL2O3 (I1 FORMAT          TPN03600
```

128

```
C                COL 13)                                                        TPN03700
C      INUNT - INPUT UNIT NUMBER (DEFAULT = 10, ALTERNATE = 5) (I2 FORMATTPN03800
C                COL, 79-80)                                                    TPN03900
       ICONTN = ICONTN+1                                                        TPN04000
   10  CONTINUE                                                                 TPN04600
       IF (ICONTN .GT. 3) GO TO 60                                              TPN04700
       READ (5,1000,END=140) NVHCLC,(METDTC(J),J=1,3),NSNDC,NMODLC,             TPN04800
      1NPLNTC,INUNT                                                             TPN04900
       IF (INUNT .EQ. 0) INUNT = 10                                             TPN05000
       IF (NVHCLC .LE. 0) ICONTN = 4                                            TPN05100
       IF (ICONTN .EQ. 4) GO TO 30                                              TPN05200
   20  CONTINUE                                                                 TPN05300
       WRITE (6,1010) NVHCLC,(METDTC(J),J=1,3),NSNDC,NMODLC,NPLNTC,INUNT        TPN05400
       WRITE (6,1030) (IVHCT(J,NVHCLC),J=1,3),(METDTC(J),J=1,3),NSNDC,          TPN05500
      1NMODLC,IPLNT(NPLNTC),INUNT                                               TPN05600
       IF (INUNT .EQ. 5) GO TO 110                                              TPN05700
       IF (ICONTN .GE. 4) GO TO 120                                             TPN05800
   30  IF (ICONTN .NE. 1.AND.ICONTN .NE. 4) GO TO 50                            TPN05900
       DEFINE FILE 10(100000,80,L,IASV)                                         TPN06600
       REWIND 12                                                                TPN06800
   50  CONTINUE                                                                 TPN06900
       IF (ICONTN .LT. 4) REWIND 12                                             TPN07000
   60  READ (12,1040,END=130) NVHCL,(METDAT(J),J=1,3),NSND,NMODL,NPLNT,         TPN07100
      1ISTRT,IEND                                                               TPN07200
       IF (ICONTN .LT. 4) GO TO 80                                              TPN07300
       NVHCLC = NVHCL                                                           TPN07400
       NMODLC = NMODL                                                           TPN07500
       NPLNTC = NPLNT                                                           TPN07600
       NSNDC = NSND                                                             TPN07700
       DO 70 I=1,3                                                              TPN07800
   70  METDTC(I) = METDAT(I)                                                    TPN07900
       GO TO 90                                                                 TPN08000
   80  CONTINUE                                                                 TPN08100
       IF (NVHCL .NE. NVHCLC) GO TO 60                                          TPN08200
       IF (METDAT(3) .NE. METDTC(3)) GO TO 60                                   TPN08300
       IF (METDAT(1) .NE. METDTC(1)) GO TO 60                                   TPN08400
       IF (METDAT(2) .NE. METDTC(2)) GO TO 60                                   TPN08500
       IF (NMODL .NE. NMODLC) GO TO 60                                          TPN08600
```

```
77*           IF (NPLNT .NE. NPLNTC) GO TO 60                                    TPN08700
78*           IF (NSND .NE. NSNDC) GO TO 60                                      TPN08800
79*     C  HAVE FOUND THE MATCH.  EXTRACT THE NAMELIST SET(CARD IMAGES ISTRT      TPN08900
80*     C  TO IEND) FROM FILE 10 AND PLACE THEM ON FILE 11 FOR NAMELIST READ.    TPN09000
81*     C                                                                        TPN09100
82*        90 DO 100 I=ISTRT,IEND                                                TPN09200
83*           IASV = I                                                           TPN09300
84*           READ (10'IASV,1050) ICARD                                          TPN09400
85*           WRITE (11,1050) ICARD                                              TPN09500
86*       100 CONTINUE                                                           TPN09600
87*           ENDFILE 11                                                         TPN09700
88*           REWIND 11                                                          TPN09800
89*           READ (11,NAM2)                                                     TPN09900
90*           REWIND 11                                                          TPN10000
91*           IF (ICONTN .GE. 4) GO TO 20                                        TPN10100
92*       110 READ (5,NAM2)                                                      TPN10200
93*           ICONTN = 2                                                         TPN10300
94*     C                                                                        TPN10400
95*     C     SAVE ID INFO. FOR SUMMARY AT END OF RUN                            TPN10500
96*       120 WRITE (9) (IVHCT(I,NVHCLC),I=1,3),(METDTC(I),I=1,3),NSNDC,NMODLC,  TPN10600
97*          1IPLNT(NPLNTC)                                                      TPN10700
98*           RETURN                                                             TPN10800
99*       130 IF (ICONTN .GE. 4) GO TO 140                                       TPN10900
100*          WRITE (6,1002)                                                     TPN11000
101*          READ (5,NAM2)                                                      TPN11100
102*          GO TO 10                                                           TPN11200
103*      140 WRITE (6,1003)                                                     TPN11300
104*          NPS = 1                                                            TPN11400
105*          IRF = 0                                                            TPN11500
106*          RETURN                                                             TPN11600
107*     1000 FORMAT(I1,3I2,I2,I3,I1,65X,I2)                                     TPN11700
108*     1002 FORMAT (1H ,49H**  ERROR - NO DATA ON TAPE FOR THE ABOVE CASE **)  TPN11800
109*     1003 FORMAT (1H1,21H**** END OF DATA ****)                              TPN11900
110*     1010 FORMAT(1H1,29X,21H  ***  CASE CARD  ***,/1H ,I1,3I2,I2,I3,I1,      TPN12000
111*         1 65X,I2,//)                                                        TPN12100
112*     1020 FORMAT(2I10)                                                       TPN12200
113*     1030 FORMAT(1H ,8HVEHICLE=,1X,3A6,/1H ,                                 TPN12300
114*         1 17HDATE OF MET DATA=,1X,I2,1H/,I2,1H/,I2,/1H ,                    TPN12400
```

```
     2 16HSOUNDING NUMBER=,I5,/1H ,13HMODEL NUMBER=,I5,                 TPN12500
     3 /1H ,10HPOLLUTANT=,1X,A6,/1H ,                                  TPN12600
     4 19HFORTRAN INPUT UNIT=,I5)                                      TPN12700
1040 FORMAT (I3,3I2,I2,I3,I1,2I6)                                      TPN12800
1050 FORMAT (13A6,A2)                                                  TPN12900
      END                                                              TPN13000
```


131

```
      SUBROUTINE  DEPOS, VERSION 6,  REVISION 0

      SUBROUTINE DEPOS                                                      DEP00100
      COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,     DEP00200
     1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),         DEP00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),          DEP00400
     3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,         DEP00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),     DEP00600
     5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),    DEP00700
     6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)    DEP00800
     7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                      DEP00900
      COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),    DEP01000
     1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,ST01,        DEP01100
     2ST02,ST03,TRD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,     DEP01200
     3MPWR,II,DEP,XBARX,SQBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,        DEP01300
     4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,              DEP01400
     5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),           DEP01500
     6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,       DEP01600
     7NYSS,CDAMX(3)                                                         DEP01700
C     **** THIS SUBROUTINE CALCULATES GRAVITATIONAL DEPOSITION AT GROUND    DEP01800
C                                                                           DEP01900
C                                                                           DEP02000
      DIMENSION DTHK(21)                                                    DEP02100
      EQUIVALENCE (DTHK,XAST)                                               DEP02200
      REAL MPWR,L,LAMBDA                                                    DEP02300
      INTEGER TESTNO                                                        DEP02400
C                                                                           DEP02500
      WRITE (6,905)                                                         DEP02600
      NBK = 0                                                               DEP02700
      DO 10 I=1,NNZ                                                         DEP02800
C                          LIST INPUT PARAMETERS                            DEP02900
      IF (I .GT. 1) GO TO 7                                                 DEP03000
      WRITE (6,900) I,UBARK(I),UBARK(I+1),SIGAK(I),SIGAK(I+1),SIGEK(I),     DEP03100
     1SIGEK(I+1),Q(I),DELX(I),DELY(I),SIGYO(I),SIGZO(I),ALPHA(I),BETA(I)    DEP03200
     2,THETAK(I),TAUK,TAUOK,Z(I),THETAK(I+1)                                DEP03300
      GO TO 8                                                               DEP03400
    7 CONTINUE                                                              DEP03500
      WRITE (6,906) I,UBARK(I+1),SIGAK(I+1),SIGEK(I+1),Q(I),DELX(I),        DEP03600
```

```
39*       1DELY(I),SIGYO(I),SIGZO(I),ALPHA(I),BETA(I),Z(I),THETAK(I+1)                DEP03700
40*      8 IF (I .LT. NNZ) GO TO 9                                                    DEP03800
41*        WRITE (6,907) Z(I+1)                                                       DEP03900
42*      9 SIGAP(I) = SIGAK(I)*(TAUK/TAUOK)**(0.2)                                    DEP04000
43*     10 CONTINUE                                                                   DEP04100
44*        WRITE (6,901) (I,VS(I),I,PERC(I),I=1,NVS)                                  DEP04200
45*        WRITE (6,902) (I,GAMMAP(I),I=1,NVS)                                        DEP04300
46*        IF (NVB .LE. 0) GO TO 12                                                   DEP04400
47*        WRITE (6,908) HB,(I,VB(I),I,PERCB(I),I=1,NVB)                              DEP04500
48*     12 CONTINUE                                                                   DEP04600
49*        THETA(1) = THETAK(1)                                                       DEP04700
50*        IF (THETA(1) .LT. 180.0) THET = (THETA(1)+180.0)*RAD                       DEP04800
51*        IF (THETA(1) .GE. 180.0) THET = (THETA(1)-180.0)*RAD                       DEP04900
52*        DTHK(1) = 0.0                                                              DEP05000
53*        DO 20 N=2,NZS                                                              DEP05100
54*     20 DTHK(N) = DTHK(N-1)+DELTHP(N-1)                                            DEP05200
55*        NYSS = NYS                                                                 DEP05300
56*        IF (NYS .GT. 0) GO TO 23                                                   DEP05400
57*        S = THETA(1)+0.5*DTHK(NZS)/FLOAT(NNZ)+180.0                                DEP05500
58*        S = AMOD(S,360.0)                                                          DEP05600
59*        S = AMOD(S,360.0)                                                          DEP05700
60*        NYS = 41                                                                   DEP05800
61*        NYSS = 41                                                                  DEP05900
62*        DO 22 J=1,NYS                                                              DEP06000
63*     22 YY(J) = YSV(J)+S                                                           DEP06100
64*     23 CONTINUE                                                                   DEP06200
65*        DO 25 N=2,NZS                                                              DEP06300
66*     25 DTHK(N) = DTHK(N)*RAD                                                      DEP06400
67*        DO 30 J=1,NYS                                                              DEP06500
68*        DO 30 I=1,NXS                                                              DEP06600
69*     30 DEPN(I,J) = 0.0                                                            DEP06700
70*        NTAD = 1                                                                   DEP06800
71*        NTAL = 1                                                                   DEP06900
72*        IF (NVB .GT. 0) NTAD = 2                                                   DEP07000
73*        IF (NVB .LE. 0.AND.NNZ .EQ. 1) NTAL = 2                                    DEP07100
74*        DO 73 JF=NTAL,NTAD                                                         DEP07200
75*        NTAP = NVS                                                                 DEP07300
76*        IF (JF .EQ. 2) NTAP = NVB                                                  DEP07400
```


133

```
      DO 73 II=1,NTAP                                                    DEP07500
      IF (JF .EQ. 2.OR.VS(II) .LE. 10.0) GO TO 35                        DEP07600
      WRITE (6,903) VS(II)                                               DEP07700
      RETURN                                                             DEP07800
   35 CONTINUE                                                           DEP07900
      NTAK = 1                                                           DEP08000
      NTAR = NNZ                                                         DEP08100
      IF (NVB .LE. 0) GO TO 45                                           DEP08200
      IF (JF .EQ. 2) GO TO 40                                            DEP08300
      NTAR = NTAR-1                                                      DEP08400
      GO TO 45                                                           DEP08500
   40 NTAK = NNZ                                                         DEP08600
   45 DO 72 KK=NTAK,NTAR                                                 DEP08700
      IF (JF .EQ. 2) GO TO 50                                            DEP08800
      IZ = 1                                                             DEP08900
      S = ((Z(KK+1)-Z(KK))*.3333333)+Z(KK)                               DEP09000
      CALL SGP(S,KK,SIGENK(1),1,IDMY,DMY,DMY,1)                          DEP09100
      CALL SGP(S,KK,DMY,2,IZ,UBHK,DMY,2)                                 DEP09200
C     DETERMINE NO. SOURCES IN LINE SOURCE SIMULATION                    DEP09300
      DHK = ACCUR*SIGENK(1)*SQBAR*SQRT(1.0+VS(II)/UBHK)                  DEP09400
      IF (DHK .LT. 10.0) DHK = 10.0                                      DEP09500
      S = (Z(KK+1)-Z(KK))/DHK                                            DEP09600
      NXCI = S+1.0                                                       DEP09700
      IF (NXCI .LT. 3) NXCI = 3                                          DEP09800
      IF (NXCI .GT. 40) NXCI = 40                                        DEP09900
      IF (JF .EQ. 1) WRITE (6,909) VS(II),KK,NXCI                        DEP10000
      DHK = (Z(KK+1)-Z(KK))/FLOAT(NXCI)                                  DEP10100
      STO1 = Z(KK)                                                       DEP10200
      GO TO 55                                                           DEP10300
   50 NXCI = 1                                                           DEP10400
      STO1 = 0.0                                                         DEP10500
      DHK = HB                                                           DEP10600
   55 DO 60 IZ=1,NXCI                                                    DEP10700
      STO1 = STO1+DHK                                                    DEP10800
      ZZL(IZ) = STO1                                                     DEP10900
      CALL SGP(ZZL(IZ),KK,SIGENK(IZ),1,IDMY,DMY,DMY,1)                   DEP11000
      CALL SGP(ZZL(IZ),KK,SIGANK(IZ),2,IDMY,DMY,DMY,1)                   DEP11100
      CALL SGP(ZZL(IZ),KK,DMY,2,IZ,UBHK,DMY,2)                           DEP11200
```

```
      CALL SGP(ZZL(IZ),KK,DMY,2,IZ,DMY,DMY,4)                          DEP11300
   60 CONTINUE                                                         DEP11400
      DO 71 I=1,NXS                                                    DEP11500
      DO 71 J=1,NYS                                                    DEP11600
      CALL COORD(N,1,X,Y,XX(I),YY(J),ASP,XS,1)                         DEP11700
      IF (N .EQ. 9) GO TO 71                                           DEP11800
      DO 70 IZ=1,NXCI                                                  DEP11900
      PHI = ABS(ASP-(THET+ANG(IZ)))                                    DEP12000
      IF (PHI .GT. 3.1415926536) PHI = 6.2831853072-PHI                DEP12100
      Y =XS*SIN(PHI)                                                   DEP12200
      X =XS*COS(PHI)                                                   DEP12300
      IF (X .LE. 0.0) GO TO 70                                         DEP12400
      DEP = 0.0                                                        DEP12500
      CALL SGP(DMY,KK,DMY,2,IZ,DMY,X,3)                                DEP12600
      IF (SIGYNK .LE. 0.0) GO TO 70                                    DEP12700
      DMY = -0.5*(Y/SIGYNK)**2                                         DEP12800
      IF (DMY .LT. -30.0) GO TO 70                                     DEP12900
      DEP = DEP*EXP(DMY)                                               DEP13000
      DEPN(I,J) = DEPN(I,J)+DEP                                        DEP13100
   70 CONTINUE                                                         DEP13200
   71 CONTINUE                                                         DEP13300
   72 CONTINUE                                                         DEP13400
   73 CONTINUE                                                         DEP13500
C     OUTPUT GRAVITATIONAL DEPOSITION                                  DEP13600
      DO 80 I=1,NXS                                                    DEP13700
      DO 80 J=1,NYSS                                                   DEP13800
   80 CDAMX(1) = AMAX1(CDAMX(1),DEPN(I,J))                             DEP13900
      MULS = 6                                                         DEP14000
      ZZL(1) = Z(1)                                                    DEP14100
      ZBSL = Z(1)                                                      DEP14200
      ZTPL = Z(NZS)                                                    DEP14300
      CALL GENPRT(1,ZBSL,ZTPL)                                         DEP14400
C                                                                      DEP14500
      DO 90 I=1,NXS                                                    DEP14600
      DO 90 J=1,NYS                                                    DEP14700
      DEPN(I,J) = 0.0                                                  DEP14800
   90 CONTINUE                                                         DEP14900
      RETURN                                                           DEP15000
```

```
153*      900 FORMAT (23H0*** DATA INPUTS LAYER ,I2,18H, UBARK AT BOTTOM=,F8.4,1DEP15100
154*         15H, UBARK AT TOP=,F8.4,18H, SIGAK AT BOTTOM=,F8.5,15H, SIGAK AT TODEP15200
155*         2P=,F8.5/17H SIGEK AT BOTTOM=,F8.5,15H, SIGEK AT TOP=,F8.5,4H, Q=,EDEP15300
156*         314.8,7H, DELX=,E14.8,7H, DELY=,E14.8/7H SIGYO=,F9.4,8H, SIGZO=,F9.DEP15400
157*         44,8H, ALPHA=,F4.1,7H, BETA=,F4.1,19H, THETAK AT BOTTOM=,F6.3,7H, TDEP15500
158*         5AUK=,F8.3,8H, TAUOK=,F8.3/4H  Z=,F9.3                              DEP15600
159*         6,16H, THETAK AT TOP=,F8.3)                                         DEP15700
160*      901 FORMAT (1H0,3(3HVS(,I2,2H)=,F10.5,7H, PERC(,I2,2H)=,F10.5,2H, )/(1DEP15800
161*         1X,3HVS(,I2,2H)=,F10.5,7H, PERC(,I2,2H)=,F10.5,5H, VS(,I2,2H)=,F10.DEP15900
162*         25,7H, PERC(,I2,2H)=,F10.5,5H, VS(,I2,2H)=,F10.5,7H, PERC(,I2,2H)=,DEP16000
163*         3F10.5,2H, ))                                                       DEP16100
164*      902 FORMAT ((1X,7(7HGAMMAP(,I2,2H)=,F5.3,2H, )))                       DEP16200
165*      903 FORMAT (1H0,67H****** ERROR ****** VS HAS EXCEEDED MAXIMUM ALLOWABDEP16300
166*         1LE VALUE 10, VS=,F9.4)                                             DEP16400
167*      905 FORMAT (1H1,48X,36H***** GRAVITATIONAL DEPOSITION *****)           DEP16500
168*      906 FORMAT (8H0 LAYER ,I2,15H, UBARK AT TOP=,F8.4,15H, SIGAK AT TOP=,FDEP16600
169*         18.5,15H, SIGEK AT TOP=,F8.5,4H, Q=,E14.8,7H, DELX=,E14.8/6H DELY=,DEP16700
170*         2E14.8,8H, SIGYO=,F9.4,8H, SIGZO=,F9.4,8H, ALPHA=,F4.1,7H, BETA=,F4DEP16800
171*         3.1,4H, Z=,F9.3/15H THETAK AT TOP=,F8.3)                            DEP16900
172*      907 FORMAT (1X,10H Z AT TOP=,F10.4)                                    DEP17000
173*      908 FORMAT (1X,19HHEIGHT OF BURST HB=,F10.4,3HVB(,I2,2H)=,F10.5,8H, PEDEP17100
174*         1RCB(,I2,2H)=,F10.5,2H, /(1X,3HVB(,I2,2H)=,F10.5,8H, PERCB(,I2,2H)=DEP17200
175*         2,F10.5,5H, VB(,I2,2H)=,F10.5,8H, PERCB(,I2,2H)=,F10.5,5H, VB(,I2, DEP17300
176*         32H)=,F10.5,8H, PERCB(,I2,2H)=,F10.5,2H, ))                         DEP17400
177*      909 FORMAT (1H0,10X,4HVS =,F8.4,12H, LAYER NO. ,I2,18H, NO. OF SOURCESDEP17500
178*         1 =,I6)                                                             DEP17600
179*          END                                                                DEP17700
```

```
1*            SUBROUTINE GENPRT, VERSION 6, REVISION 0
2*
3*            SUBROUTINE GENPRT(K,ZBSL,ZTPL)                                                    GPT00100
4*            COMMON /PARAM1/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,                 GPT00200
5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),                     GPT00300
6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),                      GPT00400
7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(10),TAUK,TAUOK,H,XRY,XRZ,                     GPT00500
8*           4XLRY,XLRZ,ZBL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),                 GPT00600
9*           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),                GPT00700
10*          6HD,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)               GPT00800
11*          7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                                 GPT00900
12*           COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),               GPT01000
13*          1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,ST01,                   GPT01100
14*          2ST02,ST03,TKD,ILK,RAD,NNZ,ITOP,IBOT,XMST(21),SIGXNK,JF,PPWR,GPWR,                GPT01200
15*          3MPWR,II,DEP,XBARX,SQBAR,NACI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,                   GPT01300
16*          4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                         GPT01400
17*          5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),                      GPT01500
18*          6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,                  GPT01600
19*          7NYSS,COAMX(3)                                                                    GPT01700
20*    C     THIS PROGRAM CONTROLS PRINTING OF ALL PROGRAM CALCULATIONS                        GPT01800
21*           DIMENSION LINE(1),YB(1),DPN(41,1),IX(1)                                          GPT01900
22*           DIMENSION JLINE(70),KLINE(10),NUNIT(8)                                           GPT02000
23*           REAL LAMBDA                                                                      GPT02100
24*           COMMON /LBLLBL/ J1(9),J2(4),J3(48),J5(6),J7(3),J8(16),J9(13),J10,                GPT02200
25*          1J4(12),J11(2),UNIT(15)                                                           GPT02300
26*           EQUIVALENCE (YBARY,LINE),(YB,SIGENK),(DPN,BETANK),(IX,X1)                        GPT02400
27*           COMMON /BNDS/ XRIT,XLFT,YBOT,YTOP,XPL,YPL                                        GPT02500
28*           COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY,                GPT02600
29*          1XSIZE1,YSIZE1                                                                    GPT02700
30*           COMMON /PLTLLO/ ISW,XMAXJN,YMAXJN,XCIZE,YCIZE                                    GPT02800
31*           COMMON /XYXYPT/ YP(41),XP(41),A(41),B(41),C(41),D(41),XI(41),YI(41GPT02900
32*          1),NUM(3),NC                                                                      GPT03000
33*           DATA ISP/1HU/,JSP/1H /,MS/57/                                                    GPT03100
34*           DATA UNIT/1H ,5H(PPM),1H ,6H    (P,6HPM SEC,1H),6H    (S,6HECONDS,GPT03200
35*          11H),6H    (M,6HG/M**3,1H),5H  (MG,6HSEC/M*,3H*3)/                               GPT03300
36*           DATA NUNIT/6H(MG/M*,3H*2),4H(PH),1H ,6HMG/M**,1H2,4H  PH,1H /                    GPT03400
37*           DATA ZEROES/0.0/                                                                 GPT03410
38*           JM = 5                                                                           GPT03500
```


137

```
39*           IT1 = 1                                                    GPT03600
40*           IT2 = 7                                                    GPT03700
41*           IT3 = 13                                                   GPT03800
42*           J4(9) = NUNIT(5)                                           GPT03900
43*           J4(10) = NUNIT(6)                                          GPT04000
44*           LFLG4 = 0                                                  GPT04100
45*           NCV1 = 14                                                  GPT04200
46*           NCV2 = 7                                                   GPT04300
47*           NCV3 = 24                                                  GPT04400
48*           IF (KSW(1) .LE. 0) GO TO 10                                GPT04500
49*          .IT1 = 19                                                   GPT04600
50*           GO TO 20                                                   GPT04700
51*        10 IF (KSW(2) .LE. 0) GO TO 30                                GPT04800
52*           LFLG4 = 0                                                  GPT04900
53*           IF (ISKIP(9) .EQ. 0) GO TO 15                              GPT05000
54*           IF (ISKIP(5) .NE. 1) GO TO 15                              GPT05100
55*           LFLG4 = 1                                                  GPT05200
56*           J4(9) = NUNIT(7)                                           GPT05300
57*           J4(10) = NUNIT(8)                                          GPT05400
58*        15 CONTINUE                                                   GPT05500
59*           IT1 = 31                                                   GPT05600
60*        20 NCV1 = 25                                                  GPT05700
61*           NCV2 = -1                                                  GPT05800
62*           NCV3 = -1                                                  GPT05900
63*           JM = 1                                                     GPT06000
64*        30 CONTINUE                                                   GPT06100
65*           XPRT = TIMAV/60.0                                          GPT06200
66*           NASS = NXS-2                                               GPT06300
67*           IF (ISKIP(1) .LE. 0) GO TO 170                             GPT06400
68*     C     PRINT GENERAL GRID CALCULATIONS                            GPT06500
69*     C     GET Y IN PROPER INTERVAL                                   GPT06600
70*           DO 100 J=1,NYSS                                            GPT06700
71*           YB(J) = AMOD(YY(J),360.0)                                  GPT06800
72*           IF (YB(J) .LT. 0.0) YB(J) = 360.0+YB(J)                    GPT06900
73*       100 CONTINUE                                                   GPT07000
74*           IB = 0                                                     GPT07100
75*           DO 160 KS=1,JM                                             GPT07200
76*           IF (JM .EQ. 1) GO TO 110                                   GPT07300
```

138

```
 77*           IF (KS .EQ. 5) IB = 1                                          GPT07400
 78*           CALL INPTS(KS,IB,NXS,11,NYSS,DEPN,SIGANK)                      GPT07500
 79*       110 CALL HEDING(KSW,KS,1,0)                                        GPT07600
 80*           CALL LABELS(K)                                                 GPT07700
 81*           CALL VRTCLE(KS,JM,KSW,SIGANK,ISKIP(5),NCV,LFLG4)               GPT07800
 82*           N1 = -9                                                        GPT07900
 83*       120 N1 = N1+10                                                     GPT06000
 84*           N2 = N1+9                                                      GPT08100
 85*           IF (N1 .GT. NYSS) GO TO 160                                    GPT08200
 86*           IF (N2 .GT. NYSS) N2 = NYSS                                    GPT08300
 87*           LINES = 80                                                     GPT08400
 88*           DO 150 I=1,NXSS                                                GPT08500
 89*           LINES = LINES+1                                                GPT08600
 90*           IF (LINES .LT. MS) GO TO 140                                   GPT08700
 91*           IF (JM .GT. 1) GO TO 125                                       GPT08800
 92*           CALL PRTTTL(NWD,LINES,LINE,0.0,0.0,ZBSL,ZTPL)                  GPT08900
 93*           GO TO 126                                                      GPT09000
 94*       125 CALL PRTTTL(NWD,LINES,LINE,DECAY,LAMBDA,ZBSL,ZTPL)             GPT09100
 95*       126 CONTINUE                                                       GPT09200
 96*           IF (KS .GT. 3) GO TO 130                                       GPT09300
 97*           WRITE (6,900) CDAMX(KS),(SIGANK(J),J=1,NCV)                    GPT09400
 98*           LINES = LINES+2                                                GPT09500
 99*       130 WRITE (6,901) (YB(J),J=N1,N2)                                  GPT09600
100*           WRITE (6,902) (SIGANK(J),J=1,NCV)                              GPT09700
101*           LINES = LINES+4                                                GPT09800
102*       140 WRITE (6,903) XX(1),(DEPN(1,J),J=N1,N2)                        GPT09900
103*       150 CONTINUE                                                       GPT10000
104*           IF (N2 .LT. NYSS) GO TO 120                                    GPT10100
105*       160 CONTINUE                                                       GPT10200
106*       170 CONTINUE                                                       GPT10300
107*           IF (JM .GT. 1) GO TO 190                                       GPT10400
108*           DO 180 I=1,NXS                                                 GPT10500
109*           KOUT = 4*I-3                                                   GPT10600
110*           CALL INTOUT(DEPN,KOUT,NYSS,2,41,I)                             GPT10700
111*       180 CONTINUE                                                       GPT10800
112*       190 CONTINUE                                                       GPT10900
113*     C     PRINT AND/OR PLOT CENTERLINE CALCULATIONS                      GPT11000
114*           IF (ISKIP(2) .LE. 0) GO TO 480                                 GPT11100
```

```
115*            IB = 0                                                                  GPT11200
116*            DO 340 KS=1,JM                                                          GPT11300
117*            IF (JM .EQ. 1) GO TO 250                                                GPT11400
118*            IF (KS .EQ. 5) IB = 1                                                   GPT11500
119*            CALL INPTS(KS,IB,NXS,II,NYSS,DEPN,SIGANK)                               GPT11600
120*        250 CONTINUE                                                                GPT11700
121*            DO 340 I=1,NXS                                                          GPT11800
122*            I1 = IX(I)                                                              GPT11900
123*            IF (KS .GT. 1) GO TO 270                                                GPT12000
124*            IX(I) = NYSS/2+1                                                        GPT12100
125*            YMAX = 0.0                                                              GPT12200
126*      C     FIND INDEX AT OR CLOSE TO MAXIMUM                                       GPT12300
127*      C     OR MINIMUM OTHER THAN ZERO IF LFLG4 = 1 (PRECIP DEP IN PH)              GPT12400
128*            IF (LFLG4 .EQ. 1) YMAX = 1.0E8                                          GPT12500
129*            DO 260 J=1,NYSS                                                         GPT12600
130*            IF (LFLG4 .EQ. 1) GO TO 155                                             GPT12700
131*            IF (DEPN(I,J) .LE. YMAX) GO TO 260                                      GPT12800
132*            GO TO 156                                                               GPT12900
133*        155 IF (DEPN(I,J) .GE. YMAX) GO TO 260                                      GPT13000
134*            IF (DEPN(I,J) .LE. 0.0) GO TO 260                                       GPT13100
135*        156 CONTINUE                                                                GPT13200
136*            IX(I) = J                                                               GPT13300
137*            YMAX = DEPN(I,J)                                                        GPT13400
138*        260 CONTINUE                                                                GPT13500
139*            I1 = IX(I)                                                              GPT13600
140*            YP(I) = YY(I1)                                                          GPT13700
141*        270 I2 = MAX0(1,I1-3)                                                       GPT13800
142*            I3 = MIN0(NYSS,I1+3)                                                    GPT13900
143*        271 IF (DEPN(I,I2) .GT. 0.0) GO TO 272                                      GPT14000
144*            I2 = I2+1                                                               GPT14100
145*            IF (I2 .LT. I1) GO TO 271                                               GPT14200
146*        272 IF (DEPN(I,I3) .GT. 0.0) GO TO 273                                      GPT14300
147*            I3 = I3-1                                                               GPT14400
148*            IF (I3 .GT. I1) GO TO 272                                               GPT14500
149*        273 IF (I3-I2 .LT. 2) GO TO 275                                             GPT14600
150*            YPL = DEPN(I,I2)/DEPN(I,I3)                                             GPT14700
151*            IF (YPL .LE. 10.0.AND.YPL .GE. 0.1) GO TO 275                           GPT14800
152*            IF (DEPN(I,I2) .LT. DEPN(I,I3)) GO TO 274                               GPT14900
```

```
153*            I2 = I2+1                                                                    GPT15000
154*            IF (I2 .GT. I1) I2 = I1                                                      GPT15100
155*            GO TO 275                                                                    GPT15200
156*        274 I3 = I3-1                                                                    GPT15300
157*            IF (I3 .LT. I1) I3 = I1                                                      GPT15400
158*        275 DPN(I,KS) = DEPN(I,I1)                                                       GPT15500
159*            IF (I1 .EQ. I2.OR.I1 .EQ. I3) GO TO 340                                      GPT15600
160*            I3 = I3-I2+1                                                                 GPT15700
161*            IF (I3 .LT. 3) GO TO 340                                                     GPT15800
162*            IF (KS .GT. 1.AND.KS .NE. 4) GO TO 310                                       GPT15900
163*            DO 280 J=1,I3                                                                GPT16000
164*        280 XP(J) = ALOG(DEPN(I,I2+J-1))                                                 GPT16100
165*            CALL SPLINE(YY(I2),XP,A,B,C,D,I3,IER)                                        GPT16200
166*            IF (IER .EQ. 1) GO TO 340                                                    GPT16300
167*            IF (KS .GT. 1) GO TO 310                                                     GPT16400
168*            I3 = I1                                                                      GPT16500
169*            I4 = I1+1                                                                    GPT16600
170*            IF (LFLG4 .EQ. 1) GO TO 282                                                  GPT16700
171*            IF (DEPN(I,I4) .GT. DEPN(I,I1-1)) GO TO 290                                  GPT16800
172*            IF (DEPN(I,I4) .LT. DEPN(I,I1-1)) GO TO 285                                  GPT16900
173*            GO TO 283                                                                    GPT17000
174*        282 IF (DEPN(I,I4) .LT. DEPN(I,I1-1)) GO TO 290                                  GPT17100
175*            IF (DEPN(I,I4) .GT. DEPN(I,I1-1)) GO TO 285                                  GPT17200
176*        283 CONTINUE                                                                     GPT17300
177*            IF (ABS(YY(I3)-YY(I3-1))-ABS(YY(I3)-YY(I4))) 290,340,285                     GPT17400
178*        285 I3 = I1-1                                                                    GPT17500
179*            I4 = I1                                                                      GPT17600
180*        290 I5 = I3-I2+1                                                                 GPT17700
181*            I6 = I4-I2+1                                                                 GPT17800
182*            A(41) = 0.5*A(I5)                                                            GPT17900
183*            B(41) = (2.0*C(I5)+C(I6)+A(I5)*(-YY(I4)-2.0*YY(I3)))*.33333333               GPT18000
184*            C(41) = B(I5)+(YY(I4)*(2.0*(A(I5)*YY(I3)-C(I5))-C(I6))+YY(I3)*(-2.           GPT18100
185*           10*C(I5)-C(I6)+A(I5)*YY(I3)))*.16666666                                       GPT18200
186*            YMAX = B(41)*B(41)-4.0*A(41)*C(41)                                           GPT18300
187*            IF (YMAX .LT. 0.0) GO TO 340                                                 GPT18400
188*            YMAX = SQRT(YMAX)                                                            GPT18500
189*            YPL = 1.0/(2.0*A(41))                                                        GPT18600
190*            YP(1) = (-B(41)-YMAX)*YPL                                                    GPT18700
```

```
      XPL = (-B(41)+YMAX)*YPL                                                GPT18800
      IF (ABS(YY(I1)-YP(I)) .GT. ABS(YY(I1)-XPL)) YP(I) = XPL                GPT18900
  310 I3 = I1                                                                GPT19000
      I4 = I1+1                                                              GPT19100
      IF (YY(I3) .LE. YP(I).AND.YP(I) .LE. YY(I4)) GO TO 320                 GPT19200
      I3 = I1-1                                                              GPT19300
      I4 = I1                                                                GPT19400
  320 IF (KS .EQ. 4) GO TO 330                                               GPT19500
      XPL = YP(I)-YY(I3)                                                     GPT19600
      YPL = YP(I)-YY(I4)                                                     GPT19700
      XPL = XPL*XPL                                                          GPT19800
      YPL = YPL*YPL                                                          GPT19900
      XPL = (XPL*ALOG(DEPN(I,I4))-YPL*ALOG(DEPN(I,I3)))/(XPL-YPL)            GPT20000
      IF (XPL .LT. -80.0) XPL = -80.0                                        GPT20100
      IF (XPL .GT. 80.0) XPL = 80.0                                          GPT20200
      DPN(I,KS) = EXP(XPL)                                                   GPT20300
      GO TO 340                                                              GPT20400
  330 I3 = I3-I2+1                                                           GPT20500
      I4 = I4-I2+1                                                           GPT20600
      IF (YP(I) .LT. YY(I4)) GO TO 335                                       GPT20700
      DPN(I,KS) = DEPN(I,I4)                                                 GPT20800
      GO TO 340                                                              GPT20900
  335 XPL = YP(I)-YY(I3)                                                     GPT21000
      DPN(I,KS) = XP(15)+XPL*(B(15)+(YP(I)-YY(I4))*(2.0*C(15)+C(I6)+A(I5GPT21100
     1)*XPL)*.16666666)                                                      GPT21200
      DPN(I,KS) = EXP(DPN(I,KS))                                             GPT21300
  340 CONTINUE                                                               GPT21400
C     PRINT MAXIMUM CENTERLINE CALCULATIONS                                  GPT21500
      IF (ISKIP(2) .EQ. 2) GO TO 420                                         GPT21600
      CALL HEDING(KSK,1,2,1)                                                 GPT21700
      CALL LABELS(K)                                                         GPT21800
      LINES = 80                                                             GPT21900
      CUAMX(1) = 0.0                                                         GPT22000
      IF (LFLG4 .EQ. 1) CUAMX(1) = 14.0                                      GPT22100
      CUAMX(2) = 0.0                                                         GPT22200
      CUAMX(3) = 0.0                                                         GPT22300
      DO 350 I=1,NXS                                                         GPT22400
      DO 350 J=1,3                                                           GPT22500
```

```
      IF (LFLG4 .EQ. 1) GO TO 345                                        GPT22600
      IF (DPN(I,J) .LT. CDAMX(J)) GO TO 350                              GPT22700
      CDAMX(J) = DPN(I,J)                                                GPT22800
      IF (J .EQ. 1) GO TO 346                                            GPT22900
      GO TO 350                                                          GPT23000
  345 IF (DPN(I,J) .LE. 0.0) GO TO 350                                   GPT23100
      IF (DPN(I,J) .GT. CDAMX(J)) GO TO 350                              GPT23200
      CDAMX(J) = DPN(I,J)                                                GPT23300
      IF (J .NE. 1) GO TO 350                                            GPT23400
  346 YPL = AMOD(YP(I),360.0)                                            GPT23500
      IF (YPL .LT. 0.0) YPL = YPL+360.0                                  GPT23600
      RTOMX = XA(I)                                                      GPT23700
      ATOMX = YPL                                                        GPT23800
  350 CONTINUE                                                           GPT23900
      IF (JM .GT. 1) GO TO 370                                           GPT24000
      IF (KSW(1) .GT. 0) GO TO 360                                       GPT24100
      I1 = 31                                                            GPT24200
      I2 = 35                                                            GPT24300
      I3 = 33                                                            GPT24400
      K1 = 1                                                             GPT24500
      K2 = 2                                                             GPT24600
      IF (ISKIP(9) .EQ. 0.OR.ISKIP(5) .NE. 1) GO TO 360                  GPT24700
      K1 = 3                                                             GPT24800
      K2 = 4                                                             GPT24900
      GO TO 380                                                          GPT25000
  360 I1 = 19                                                            GPT25100
      I2 = 23                                                            GPT25200
      I3 = 21                                                            GPT25300
      K1 = 1                                                             GPT25400
      K2 = 2                                                             GPT25500
      GO TO 380                                                          GPT25600
  370 CONTINUE                                                           GPT25700
      I1 = 1                                                             GPT25800
      I2 = 5                                                             GPT25900
      I3 = 3                                                             GPT26000
      IF (ISKIP(5) .NE. 4) GO TO 380                                     GPT26100
      I1 = 10                                                            GPT26200
      I2 = 15                                                            GPT26300
```


143

```
      I3 = I2                                                                  GPT26400
  330 CONTINUE                                                                 GPT26500
      DO 410 I=1,NXSS                                                          GPT26600
      IF (DPN(I,1) .LE. 0.0) GO TO 410                                         GPT26700
      LINES = LINES+1                                                          GPT26800
      IF (LINES .LT. MS) GO TO 395                                             GPT26900
      IF (JM .GT. 1) GO TO 390                                                 GPT27000
      CALL PRTTTL(NWD,LINES,LINE,0.0,0.0,ZBSL,ZTPL)                            GPT27100
      WRITE (6,910) ISP,CDAMX(1),(J3(J),J=I1,I2),J4(9),J4(10)                  GPT27200
      WRITE (6,905) (J3(J),J=I1,I3),(NUNIT(J),J=K1,K2)                         GPT27300
      LINES = LINES+5                                                          GPT27400
      GO TO 395                                                                GPT27500
  390 CALL PRTTTL(NWD,LINES,LINE,DECAY,LAMBDA,ZBSL,ZTPL)                       GPT27600
      WRITE (6,904) ISP,CDAMX(1),(J3(J),J=1,3)                                 GPT27700
      WRITE (6,907) JSP,CDAMX(2),(J3(J),J=7,8)                                 GPT27800
      WRITE (6,908) JSP,CDAMX(3),XPRT,(J3(J),J=13,16)                          GPT27900
      WRITE (6,906) XPRT,(UNIT(J),J=I1,I2),(UNIT(J),J=I1,I3),(UNIT(J),J=GPT28000
     17,9),(UNIT(J),J=I1,I3)                                                   GPT28100
      LINES = LINES+8                                                          GPT28200
  395 CONTINUE                                                                 GPT28300
      YPL = AMOD(YP(I),360.0)                                                  GPT28400
      IF (YPL .LT. 0.0) YPL = YPL+360.0                                        GPT28500
      WRITE (6,909) XX(I),YPL,(DPN(I,J),J=1,JM)                                GPT28600
  410 CONTINUE                                                                 GPT28700
      IF (KSW(2) .EQ. 0) GO TO 415                                             GPT28800
      CDAMX(3) = -5.0                                                          GPT28900
      CDAMX(2) = 0.0                                                           GPT29000
      IF (LFLG4 .EQ. 1) CDAMX(2) = -1.0                                        GPT29100
      GO TO 416                                                                GPT29200
  415 IF (KSW(1) .EQ. 0) GO TO 416                                             GPT29300
      CDAMX(3) = -6.0                                                          GPT29400
      CDAMX(2) = 0.0                                                           GPT29500
  416 CONTINUE                                                                 GPT29600
C     SAVE MAX VALUES FOR SUMMARY AT END OF RUN                                GPT29700
      WRITE (9) (CDAMX(J),J=1,3),RTOMX,ATOMX,ZZL(K),ZBSL,ZTPL                  GPT29800
C                                                                              GPT29900
C     IF MAX. PEAK CONC IS VERY LOW, ABORT THIS CASE                           GPT30000
      IF (LFLG4 .EQ. 1) GO TO 412                                              GPT30100
```

```
      IF (CDAMX(1) .GE. 0.001) GO TO 420                                GPT30200
  411 WRITE (6,911)                                                     GPT30300
      GO TO 540                                                         GPT30400
  412 IF (CDAMX(1) .GE. 10.9) GO TO 411                                 GPT30500
  420 CONTINUE                                                          GPT30600
C     PLOT MAXIMUM CENTERLINE CALCULATIONS                              GPT30700
      IF (ISKIP(2) .EQ. 1) GO TO 480                                    GPT30800
      HT = 0.0                                                          GPT30900
      XPL = 0.0                                                         GPT31000
      YPL = 0.0                                                         GPT31100
      DO 430 I=1,NXS                                                    GPT31200
      X1 = XX(I)*SIN(YP(I)*RAD)                                         GPT31300
      Y1 = XX(I)*COS(YP(I)*RAD)                                         GPT31400
      YB(I) = SQRT((X1-XPL)**2+(Y1-YPL)**2)+HT                          GPT31500
      HT = YB(I)                                                        GPT31600
      XPL = X1                                                          GPT31700
  430 YPL = Y1                                                          GPT31800
      IF (ISW .NE. 2) GO TO 436                                         GPT31900
      DO 435 I=1,NXS                                                    GPT32000
      YB(I) = ALOG10(YB(I))                                             GPT32100
  435 CONTINUE                                                          GPT32200
  436 CONTINUE                                                          GPT32300
      CALL FSTPLT(H,RNG,ALM,NAMCAS,IDATE,ITIME,CDAMX(1),CDANX(2),CDAMX(3GPT32400
     1),J3(IT1),J3(IT2),J3(IT3),NCV1,NCV2,NCV3,XPRT)                    GPT32500
      IF (JM .GT. 3) JM = 3                                             GPT32600
      DO 470 KS=1,JM                                                    GPT32700
      CALL HEDING(KSW,KS,2,0)                                           GPT32800
      CALL LABELS(K)                                                    GPT32900
      CALL VRTCLE(KS,JM,KSW,SIGANK,ISKIP(5),NCV,LFLG4)                  GPT33000
      NCV = NCV*6                                                       GPT33100
      GO TO (440,450,460),KS                                            GPT33200
  440 IF (KSW(1) .GT. 0.OR.KSW(2) .GT. 0) GO TO 450                     GPT33300
C     PLOT MAXIMUM CENTERLINE CONCENTRATION                             GPT33400
      IF (NCCC .LE. 0) GO TO 470                                        GPT33500
      CALL LLPLOT(DPN(1,KS),YB,NXSS,LINE,CI,NCCC,NWD,SIGANK,NCV,ZBSL,   GPT33600
     1Z,PL)                                                             GPT33700
      NWD = NWD*6                                                       GPT33800
      CALL LSSOPT(YB,DPN(1,KS),NXSS,NCCC,CI,SIGANK,LINE,NCV,NWD)        GPT33900
```

```
      GO TO 470                                                          GPT34000
C     CENTERLINE DEPOSITION OR DOSAGE                                    GPT34100
  450 IF (NDDD .LE. 0) GO TO 470                                         GPT34200
      CALL LLPLOT(DPN(1,KS),YB,NXSS,LINE,DI,NDDD,NWD,SIGANK,NCV,ZBSL,    GPT34300
     1ZIPL)                                                              GPT34400
      NWD = NWD*6                                                        GPT34500
      CALL LSSOPT(YB,DPN(1,KS),NXSS,NDDD,DI,SIGANK,LINE,NCV,NWD)         GPT34600
      GO TO 470                                                          GPT34700
C     CENTERLINE TIME-MEAN CONCENTRATION                                 GPT34800
  460 IF (NTTT .LE. 0) GO TO 470                                         GPT34900
      CALL LLPLOT(DPN(1,KS),YB,NXSS,LINE,TI,NTTT,NWD,SIGANK,NCV,ZBSL,    GPT35000
     1ZIPL)                                                              GPT35100
      NWD = NWD*6                                                        GPT35200
      CALL LSSOPT(YB,DPN(1,KS),NXSS,NTTT,TI,SIGANK,LINE,NCV,NWD)         GPT35300
  470 CONTINUE                                                           GPT35400
  480 CONTINUE                                                           GPT35500
      IF (ISKIP(2) .EQ. 0) WRITE (9) (ZEROES,J=1,8)                      GPT35510
C     PLOT ISOPLETHS                                                     GPT35600
      IF (ISKIP(3) .EQ. 0) GO TO 540                                     GPT35700
      IF (ISKIP(3) .EQ. 1) GO TO 485                                     GPT35800
      CALL FSTPLT(H,RNG,AZM,NAMCAS,IDATE,ITIME,CDAMX(1),CDAMX(2),CDAMX(3GPT35900
     1),JS(IT1),JS(IT2),JS(IT3),NCV1,NCV2,NCV3,XPRT)                     GPT36000
  485 CONTINUE                                                           GPT36100
      IF (JM .GT. 3) JM = 3                                              GPT36200
      DO 530 KS=1,JM                                                     GPT36300
      IF (JM .EQ. 1) GO TO 490                                           GPT36400
      CALL INPTS(KS,0,NXS,II,NYSS,DEPN,SIGANK)                           GPT36500
  490 CONTINUE                                                           GPT36600
      CALL HEDING(KSW,KS,3,0)                                            GPT36700
      CALL LABELS(K)                                                     GPT36800
      CALL VRTCLE(KS,JM,KSW,KLINE,ISKIP(5),NCV,LFLG4)                    GPT36900
      DO 495 J=1,NWD                                                     GPT37000
  495 JLINE(J) = LINE(J)                                                 GPT37100
      NWD = NWD*6                                                        GPT37200
      GO TO (500,510,520),KS                                             GPT37300
  500 IF (KSW(1) .GT. 0.OR.KSW(2) .GT. 0) GO TO 510                      GPT37400
      IF (NCC .LE. 0) GO TO 530                                          GPT37500
      CALL LSSOPT(XX,YY,NXS,NCC,CI,JLINE,NWD,DEPN,NYSS,YBARY,DEPN,II,KS,GPT37600
```

```
     1YT,ISKIP(3),KLINE,NCV,JM,DECAY,LAMBDA,ZBSL,ZTPL)                  GPT37700
      GO TO 530                                                         GPT37800
  510 IF (NDD .LE. 0) GO TO 530                                         GPT37900
      CALL ISSOPT(XX,YY,NAS,NDD,DI,JLINE,NWD,DEPN,NYSS,YBARY,DEPN,II,KS,GPT38000
     1YT,ISKIP(3),KLINE,NCV,JM,DECAY,LAMBDA,ZBSL,ZTPL)                  GPT38100
      GO TO 530                                                         GPT38200
  520 IF (NTT .LE. 0) GO TO 530                                         GPT38300
      CALL ISSOPT(XX,YY,NAS,NTT,TI,JLINE,NWD,DEPN,NYSS,YBARY,DEPN,II,KS,GPT38400
     1YT,ISKIP(3),KLINE,NCV,JM,DECAY,LAMBDA,ZBSL,ZTPL)                  GPT38500
  530 CONTINUE                                                          GPT38600
  540 CONTINUE                                                          GPT38700
      RETURN                                                            GPT38800
  900 FORMAT (1H0,36X,F9.3,21H IS THE MAXIMUM GRID ,6A6)                GPT38900
  901 FORMAT (1H0,6H RANGE,44X,29H- AZIMUTH BEARING (DEGREES) -/1X,8H(MEGPT39000
     1TERS),10(3X,F7.2,2X))                                             GPT39100
  902 FORMAT (52X,6A6)                                                  GPT39200
  903 FORMAT (1X,F8.1,10(F10.3,2X))                                     GPT39300
  904 FORMAT (A1,38X,F9.3,20H IS THE MAXIMUM PEAK,5A6)                  GPT39400
  905 FORMAT (1H0,23X,12HMAXIMUM PEAK/18H  RANGE    AZIMUTH,6X,2A6,A2/11GPT39500
     1X,24HBEARING       DEPOSITION/1X,25H(METERS) (DEGREES)        ,A6,AGPT39600
     23)                                                                GPT39700
  906 FORMAT (1H0,23X,12HMAXIMUM PEAK,13X,7HMAXIMUM,13X,12HMAXIMUM PEAK/GPT39800
     17H  RANGE,4X,7HAZIMUTH,6X,13HCONCENTRATION,13X,6HDOSAGE,8X,F5.1,17GPT39900
     2H MINUTE TIME-MEAN,8X,7HTIME OF,12X,13HAVERAGE CLOUD/11X,7HBEARINGGPT40000
     3,51X,13HCONCENTRATION,9X,13HCLOUD PASSAGE,9X,13HCONCENTRATION/1X,1GPT40100
     49H(METERS) (DEGREES) ,5(2X,3A6,2X))                               GPT40200
  907 FORMAT (A1,44X,F9.3,15H IS THE MAXIMUM,5A6)                       GPT40300
  908 FORMAT (A1,32X,F9.3,20H IS THE MAXIMUM PEAK,F5.1,7H MINUTE,5A6)   GPT40400
  909 FORMAT (1X,F8.1,2X,F8.3,6X,F10.3,11X,F10.3,13X,F10.3,2(12X,F10.3))GPT40500
  910 FORMAT (A1,32X,F9.3,20H IS THE MAXIMUM PEAK,4A6,A1,4H IN ,A6,A1)  GPT40600
  911 FORMAT (1H0,59H**  MAX. PEAK VALUES ARE INSIGNIFICANT, ABORT THIS GPT40700
     1CASE  **)                                                         GPT40800
      END                                                               GPT40900
```


147

```
      SUBROUTINE LABELS, VERSION 6,  REVISION 0

      SUBROUTINE LABELS(K)                                                    LBL00100
      COMMON /PARAMT/ TESTNO(12),         ISKIP(15),NXS,NYS,NZS,NDI,NCI,      LBL00200
     1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),           LBL00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),            LBL00400
     3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,           LBL00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),       LBL00600
     5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),      LBL00700
     6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)      LBL00800
     7,THETAL(10),GAMMAP(20),NT1,TI(10),NPS,NAMCAS(12)                        LBL00900
      COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),      LBL01000
     1DELU(20),VEK,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,STO1,          LBL01100
     2STO2,STO3,TRD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,       LBL01200
     3MPWR,II,DEP,XBARX,SQBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,          LBL01300
     4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                LBL01400
     5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),             LBL01500
     6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,         LBL01600
     7NYSS,CDAMX(3)                                                           LBL01700
      DIMENSION LINE(1)                                                       LBL01800
      COMMON /LBLLBL/ J1(9),J2(4),J3(48),J5(6),J7(3),J8(16),J9(13),J10,       LBL01900
     1J4(12),J11(2),UNIT(15)                                                  LBL02000
      EQUIVALENCE (YBARY,LINE)                                                LBL02100
      INTEGER TESTNO                                                          LBL02200
      DATA IBLNK/6H      /                                                    LBL02300
C     CHANGE FOLLOWING TWO STATEMENTS FOR 7044                                LBL02400
C     DATA IBLK/0000000000060/,IBLP/0000000000033/                            LBL02500
      DATA IBLK/0000000000005/,IBLP/0000000000075/                            LBL02600
      DATA J1/54HCALCULATIONS OF   MAXIMUM CENTERLINEISOPLETHS                /LBL02700
      DATA J11/7H MINUTE/                                                     LBL02800
      DATA J2/24H HCL   CO    CO2   AL2O3/                                    LBL02900
      DATA J3/14H CONCENTRATION,3*1H ,7H DOSAGE,4*1H ,24H TIME-MEAN CONCLBL03000
     1ENTRATION,2*2H  ,25H GRAVITATIONAL DEPOSITION,1H ,13H CALCULATIONSLBL03100
     2,3*1H ,25H PRECIPITATION DEPOSITION,1H ,22H TIME OF CLOUD PASSAGE,LBL03200
     32*1H ,28H AVERAGE CLOUD CONCENTRATION,1H /                          LBL03300
      DATA J10/3H IN/                                                         LBL03400
      DATA J4/3HPPM,1H ,6HPPM SE,1HC,6HMG/M**,1H3,6HMG SEC,5H/M**3,6HMG/LBL03500
     1M**,1H2,6HSECOND,1HS/                                                   LBL03600
```

148

```
      DATA J5/36H AT A HEIGHT OF                    METERS/                    LBL03700
      DATA J7/18H DOWNWIND FROM A  /                                           LBL03800
      DATA J8/96H STATIC FIRE.            NORMAL LAUNCH.          SINGLELBL03900
     1 ENGINE BURN.      SLOW BURN.                 /                         LBL04000
      DATA J9/78HMODEL        WAS USED IN THE CALCULATIONS AND THE METEORLBL04100
     1OLOGICAL CASE IS       /                                                 LBL04200
      DO 10 J=1,80                                                             LBL04300
   10 LINE(J) = IBLNK                                                          LBL04400
      DO 20 J=1,3                                                              LBL04500
      N = KSW(3)+J                                                             LBL04600
   20 LINE(J+3) = J1(N)                                                        LBL04700
   30 IF (TESTNO(11) .NE. IBLNK) GO TO 40                                      LBL04800
      N = ISKIP(5)                                                             LBL04900
      LINE(8) = J2(N)                                                          LBL05000
      GO TO 50                                                                 LBL05100
   40 LINE(8) = TESTNO(11)                                                     LBL05200
      LINE(9) = TESTNO(12)                                                     LBL05300
   50 IF (KSW(4) .NE. 12) GO TO 60                                             LBL05400
      B = TIMAV/60.0                                                           LBL05500
      CALL NMBRS(B,LINE(10),IDUM)                                              LBL05600
      LINE(12) = J11(1)                                                        LBL05700
      LINE(13) = J11(2)                                                        LBL05800
   60 DO 70 J=1,6                                                              LBL05900
      N = KSW(4)+J                                                             LBL06000
   70 LINE(J+13) = J3(N)                                                       LBL06100
      IF (KSW(4) .NE. 24) LINE(20) = J10                                       LBL06200
      IF (KSW(4) .EQ. 24) GO TO 100                                            LBL06300
      M = 8                                                                    LBL06400
      IF (KSW(4) .EQ. 30.OR.KSW(4) .EQ. 18) GO TO 80                           LBL06500
      M = 0                                                                    LBL06600
      IF (ISKIP(5) .EQ. 4) M = 4                                               LBL06700
      IF (KSW(4) .EQ. 6) M = M+2                                               LBL06800
      IF (KSW(4) .EQ. 36) M = 10                                               LBL06900
   80 DO 90 J=1,2                                                              LBL07000
      N = M+J                                                                  LBL07100
   90 LINE(J+20) = J4(N)                                                       LBL07200
  100 DO 110 J=1,6                                                             LBL07300
  110 LINE(J+22) = J5(J)                                                       LBL07400
```


149

```
77*           CALL NMBRS(ZZL(K),LINE(26),IDUM)                          LBL07500
78*       130 DO 140 J=1,3                                              LBL07600
79*       140 LINE(J+28) = J7(J)                                        LBL07700
80*           DO 150 J=1,4                                              LBL07800
81*       150 LINE(J+31) = TESTNO(J+6)                                  LBL07900
82*           IF (ISKIP(6) .EQ. 5) GO TO 165                            LBL08000
83*           DO 160 J=1,4                                              LBL08100
84*           N = ISKIP(6) *4-4+J                                       LBL08200
85*       160 LINE(J+35) = J8(N)                                        LBL08300
86*       165 J = 39                                                    LBL08400
87*           NWD = 1                                                   LBL08500
88*           GO TO 190                                                 LBL08600
89*       166 IF (N .EQ. 6) JS = JS+1                                   LBL08700
90*           DO 170 J=1,13                                             LBL08800
91*       170 LINE(J+JS) = J9(J)                                        LBL08900
92*           B = MDLS                                                  LBL09000
93*           CALL NMBRS(B,LINE(JS+2),IDUM)                             LBL09100
94*           JS = JS+13                                                LBL09200
95*           DO 180 J=1,6                                              LBL09300
96*       180 LINE(J+JS) = TESTNO(J)                                    LBL09400
97*           J = JS+6                                                  LBL09500
98*           NWD = 2                                                   LBL09600
99*       190 N = 7                                                     LBL09700
100*      191 N = N-1                                                   LBL09800
101*          IF (N .GT. 0) GO TO 200                                   LBL09900
102*          N = 6                                                     LBL10000
103*          J = J-1                                                   LBL10100
104*      200 JS = IABS(6*(N-1))                                        LBL10200
105*          M = 0                                                     LBL10300
106*          CALL MSFLD(JS,6,LINE(J),30,M)                             LBL10400
107*          IF (M .EQ. IBLK) GO TO 191                                LBL10500
108*          IF (M .EQ. IBLP) GO TO 220                                LBL10600
109*          N = N+1                                                   LBL10700
110*          IF (N .LT. 7) GO TO 210                                   LBL10800
111*          N = 1                                                     LBL10900
112*          J = J+1                                                   LBL11000
113*      210 JS = IABS(6*(N-1))                                        LBL11100
114*          CALL MSFLD(30,6,IBLP,JS,LINE(J))                          LBL11200
```

```
115*          220 JS = J                                                    LBL11300
116*              GO TO (160,230),NWD                                       LBL11400
117*          230 NWD = JS                                                  LBL11500
118*              CALL PACKS(LINE,NWD)                                      LBL11600
119*              RETURN                                                    LBL11700
120*              END                                                       LBL11800
```


151

```
      SUBROUTINE  PACKS, VERSION  5, REVISION 0

      SUBROUTINE PACKS(LINE,NWD)                                          PCK00100
C     THIS SUBROUTINE REMOVES EXCESSIVE BLANKS FROM THE TITLE AND PACKS   PCK00200
C     IT INTO SUCCESSIVE LINES OF 15 WORDS PER LINE                       PCK00300
      DIMENSION LINE(1)                                                   PCK00400
      DATA IBLK/0000000000005/                                            PCK00500
CC    DATA IBLK/0000000000000/  - IBM 7044 -                              PCK00600
      NFLG = 0                                                            PCK00700
      NK = 0                                                              PCK00800
      JB = 16                                                             PCK00900
C     JB IS 15+1 OR 15 WORDS PER LINE                                     PCK01000
      IB = 1                                                              PCK01100
      LST = IBLK                                                          PCK01200
      M = 1                                                               PCK01300
      N = 0                                                               PCK01400
      J = 0                                                               PCK01500
   10 J = J+1                                                             PCK01600
      IF (J .LE. NWD) GO TO 15                                            PCK01700
      NFLG = 1                                                            PCK01800
      L = IBLK                                                            PCK01900
      N1 = N+1                                                            PCK02000
      IF (N1 .GT. 6) GO TO 60                                             PCK02100
      M1 = M                                                              PCK02200
      GO TO 60                                                            PCK02300
   15 K = LINE(J)                                                         PCK02400
      I = 0                                                               PCK02500
   20 I = I+1                                                             PCK02600
      IF (I .GT. 6) GO TO 10                                              PCK02700
      II = IABS(6*(I-1))                                                  PCK02800
      CALL MSFLD(II,6,K,30,L)                                             PCK02900
      IF (L .NE. IBLK) GO TO 30                                           PCK03000
      IF (LST .EQ. IBLK) GO TO 20                                         PCK03100
   25 IBLK = I                                                            PCK03200
      JBLK = J                                                            PCK03300
   30 N = N+1                                                             PCK03400
      NK = NK+1                                                           PCK03500
      IF (N .LT. 7) GO TO 40                                              PCK03600
```

```
      N = 1                                                              PCK03700
      IB = IB+1                                                          PCK03800
      M = M+1                                                            PCK03900
   40 I1 = IABS(6*(N-1))                                                 PCK04000
      IF (L .NE. IBLK) GO TO 50                                          PCK04100
      NNBLK = N                                                          PCK04200
      MMBLK = M                                                          PCK04300
   50 IF (IB .LT. JB) GO TO 70                                           PCK04400
      IF (LST .EQ. IBLK.OR.L .EQ. IBLK) GO TO 69                         PCK04500
      L = IBLK                                                           PCK04600
      NR = NR-1                                                          PCK04700
      N1 = NNBLK+1                                                       PCK04800
      M1 = MMBLK                                                         PCK04900
      IF (N1 .LT. 7) GO TO 60                                            PCK05000
      M1 = M1+1                                                          PCK05100
      N1 = 1                                                             PCK05200
   60 I1 = IABS(6*(N1-1))                                                PCK05300
      CALL MSFLD(30,6,L,I1,LINE(M1))                                     PCK05400
      IF (NFLG .EQ. 1) GO TO 63                                          PCK05500
      GO TO 64                                                           PCK05600
   63 NR = NR+1                                                          PCK05700
   64 CONTINUE                                                           PCK05800
      N1 = N1+1                                                          PCK05900
      IF (N1 .LT. 7) GO TO 60                                            PCK06000
      IF (NFLG .EQ. 1) GO TO 80                                          PCK06100
      N1 = 1                                                             PCK06200
      M1 = M1+1                                                          PCK06300
      IF (M1 .LT. M) GO TO 60                                            PCK06400
      J = JJBLK                                                          PCK06500
      I = IIBLK                                                          PCK06600
      N = 7                                                              PCK06700
      M = M-1                                                            PCK06800
      LST = IBLK                                                         PCK06900
      IB = 0                                                             PCK07000
      K = LINE(J)                                                        PCK07100
      GO TO 20                                                           PCK07200
   69 IB = 1                                                             PCK07300
      LST = IBLK                                                         PCK07400
```


153

```
      IF (L .NE. IBLK) GO TO 70                                          PCK07500
      NK = NK-1                                                          PCK07600
      IB = 0                                                             PCK07700
      N = 7                                                              PCK07800
      M = M-1                                                            PCK07900
      GO TO 20                                                           PCK08000
   70 LST = L                                                            PCK08100
   75 CALL MSFLD(30,6,L,II,LINE(M))                                      PCK08200
      GO TO 20                                                           PCK08300
   80 NWD = NR/6                                                         PCK08400
      IB = NWD*6                                                         PCK08500
      IF (IB .LT. NK) NWD = NWD+1                                        PCK08600
      RETURN                                                             PCK08700
      END                                                                PCK08800
```

```
 1*          SUBROUTINE PRTTTL, VERSION 6,  REVISION 0
 2*
 3*          SUBROUTINE PRTTTL(NWD,LINES,LINE,A,B,ZB,ZT)                          PRT00100
 4*    C     THIS SUBROUTINE PRINTS THE PAGE HEADING                              PRT00200
 5*          DIMENSION LINE(1)                                                    PRT00300
 6*          DATA IB/1H1/,JB/1H /                                                 PRT00400
 7*          N = IB                                                               PRT00500
 8*          LINES = 3                                                            PRT00600
 9*          N1= 1                                                                PRT00700
10*          N2 = 15                                                              PRT00800
11*       10 IF (N2 .GT. NWD) N2 = NWD                                            PRT00900
12*          WRITE (6,50) N,(LINE(I),I=N1,N2)                                     PRT01000
13*          LINES = LINES+1                                                      PRT01100
14*          N = JB                                                               PRT01200
15*          IF (N2 .GE. NWD) GO TO 20                                            PRT01300
16*          N1 = N2+1                                                            PRT01400
17*          N2 = N2+15                                                           PRT01500
18*          GO TO 10                                                             PRT01600
19*       20 IF (A .GE. 0.0) WRITE (6,80)                                         PRT01700
20*          LINES = LINES+1                                                      PRT01800
21*          IF (A .LE. 0.0) GO TO 30                                             PRT01900
22*          WRITE (6,60)                                                         PRT02000
23*          LINES = LINES+1                                                      PRT02100
24*       30 IF (B .LE. 0.0) GO TO 40                                             PRT02200
25*          WRITE (6,70)                                                         PRT02300
26*          LINES = LINES+1                                                      PRT02400
27*       40 WRITE (6,90) ZB,ZT                                                   PRT02500
28*          LINES = LINES+1                                                      PRT02600
29*          RETURN                                                               PRT02700
30*       50 FORMAT (A1,19X,15A6)                                                 PRT02800
31*       60 FORMAT (42X,45H(DECAY HAS BEEN INCLUDED IN THE CALCULATIONS))        PRT02900
32*       70 FORMAT (33X,64H(PRECIPITATION SCAVENGING HAS BEEN INCLUDED IN THE    PRT03000
33*         1CALCULATIONS))                                                      PRT03100
34*       80 FORMAT ( )                                                          PRT03200
35*       90 FORMAT (34X,37HCALCULATIONS APPLY TO THE LAYER FROM ,F7.2,4H TO ,FPRT03300
36*         18.2,7H METERS)                                                      PRT03400
37*          END                                                                  PRT03500
```

```
      SUBROUTINE VRTCLE, VERSION  6,  REVISION 0
C
      SUBROUTINE VRTCLE(KS,JM,KSW,ISTOR,ISKIP5,NCV,IFLG4)                    VRT00100
      DIMENSION KSW(1),ISTOR(1)                                              VRT00200
      DIMENSION NPH(2)                                                       VRT00300
      COMMON /LBLLBL/ J1(9),J2(4),J3(48),J5(6),J7(3),J8(16),J9(13),J10,      VRT00400
     1J4(12),J11(2),UNIT(15)                                                 VRT00500
      INTEGER UNIT                                                           VRT00600
      DATA NPH/5H   PH,1H /                                                  VRT00700
      IF (JM .GT. 1) GO TO 20                                                VRT00800
      I1 = 31                                                                VRT00900
      IF (KSW(2) .GT. 0) GO TO 10                                            VRT01000
      I1 = 19                                                                VRT01100
   10 I2 = I1+4                                                              VRT01200
      I3 = 8                                                                 VRT01300
      GO TO 82                                                               VRT01400
   20 GO TO (30,40,50,60,70),KS                                              VRT01500
   30 I1 = 1                                                                 VRT01600
      I2 = 3                                                                 VRT01700
      GO TO 80                                                               VRT01800
   40 I1 = 7                                                                 VRT01900
      I2 = 8                                                                 VRT02000
      I3 = 3                                                                 VRT02100
      GO TO 81                                                               VRT02200
   50 I1 = 13                                                                VRT02300
      I2 = 17                                                                VRT02400
      GO TO 80                                                               VRT02500
   60 I1 = 37                                                                VRT02600
      I2 = 43                                                                VRT02700
      I3 = 6                                                                 VRT02800
      GO TO 82                                                               VRT02900
   70 I1 = 43                                                                VRT03000
      I2 = 47                                                                VRT03100
   80 I3 = 0                                                                 VRT03200
   81 IF (ISKP5 .EQ. 4) I3 = I3+9                                            VRT03300
   82 ISTOR(1) = J3(4)                                                       VRT03400
      DO 90 I=I1,I2                                                          VRT03500
   90 ISTOR(I-I1+2) = J3(I)                                                  VRT03600
```

```
      NCV = I2-I1+2                                                    VRT03700
      IF (JM .GT. 1) GO TO 110                                         VRT03800
      DO 100 I=1,2                                                     VRT03900
      IF (IFLG4 .NE. 0) GO TO 95                                       VRT04000
      ISTOR(NCV+I) = J4(I3+I)                                          VRT04100
      GO TO 100                                                        VRT04200
   95 ISTOR(NCV+I) = NPH(I)                                            VRT04300
  100 CONTINUE                                                         VRT04400
      NCV = NCV+2                                                      VRT04500
      GO TO 130                                                        VRT04600
  110 DO 120 I=1,3                                                     VRT04700
  120 ISTOR(NCV+I) = UNIT(I3+I)                                        VRT04800
      NCV = NCV+3                                                      VRT04900
  130 CALL PACKS(ISTOR,NCV)                                            VRT05000
      RETURN                                                           VRT05100
      END                                                              VRT05200
```


157

```
1*          SUBROUTINE  NMBRS, VERSION  5, REVISION 0
2*
3*          SUBROUTINE NMBRS(A,NUM,NC)                                  NMB00100
4*          DIMENSION IM(15),NUM(3)                                     NMB00200
5*          NC = 0                                                      NMB00300
6*          IF (A) 20,10,30                                             NMB00400
7*       10 NC = 1                                                      NMB00500
8*          NUM(1) = '0      '                                          NMB00600
9*          GO TO 110                                                   NMB00700
10*      20 NC = NC+1                                                   NMB00800
11*         IM(1) = '      -'                                          NMB00900
12*      30 B = ABS(A)                                                  NMB01000
13*         K = B                                                       NMB01100
14*         M = B                                                       NMB01200
15*         IF (M .EQ. 0) GO TO 41                                      NMB01300
16*         M = ALOG10(B)                                               NMB01400
17*         M = M+1                                                     NMB01500
18*         MM = B                                                      NMB01600
19*         DO 40 I=1,M                                                 NMB01700
20*         NC = NC+1                                                   NMB01800
21*         K = MM/10**(M-1)                                            NMB01900
22*         MM = MM-K*10**(M-1)                                         NMB02000
23*      40 IM(NC) = K+48                                               NMB02100
24*         K = 3                                                       NMB02200
25*      41 M = B                                                       NMB02300
26*         C = M                                                       NMB02400
27*         IF (B-C) 50,80,50                                           NMB02500
28*      50 NC = NC+1                                                   NMB02600
29*         IM(NC) = '      .'                                          NMB02700
30*         B = B-M                                                     NMB02800
31*         I = 0                                                       NMB02900
32*         B = B+1.0E-7                                                NMB03000
33*      60 I = I+1                                                     NMB03100
34*         NC = NC+1                                                   NMB03200
35*         B = B*10.0                                                  NMB03300
36*         M = B                                                       NMB03400
37*         B = B-M                                                     NMB03500
38*         IM(NC) = M+48                                               NMB03600
```

```
      IF (I .LT. 6) GO TO 60                                              NMB03700
   70 IF (IM(NC) .GT. 48.AND.IM(NC) .LT. 58) GO TO 80                     NMB03800
      NC = NC-1                                                           NMB03900
      IF (NC .LE. 2) GO TO 80                                             NMB04000
      GO TO 70                                                            NMB04100
   80 K = 1                                                               NMB04200
      M = 0                                                               NMB04300
      DO 100 I=1,NC                                                       NMB04400
      M = M+1                                                             NMB04500
      IF (M .LT. 7) GO TO 90                                              NMB04600
      M = 1                                                               NMB04700
      K = K+1                                                             NMB04800
   90 CALL MSFLD(30,6,IM(I),IABS(6*(M-1)),NUM(K))                         NMB04900
  100 CONTINUE                                                            NMB05000
  110 CONTINUE                                                            NMB05100
      RETURN                                                              NMB05200
      END                                                                 NMB05300
```


159

```
      SUBROUTINE HEDING, VERSION  5, REVISION 0
C
      SUBROUTINE HEDING(KSW,KS,JSW,LSW)                                 HED00100
C     SET ALL PARAMETERS NEC TO BUILDING PAGE HEADING                   HED00200
      DIMENSION KSW(1)                                                  HED00300
      KSW(3) = 3*JSW-3                                                  HED00400
      GO TO (10,40,50,60,70),KS                                         HED00500
   10 IF (KSW(1) .EQ. 0) GO TO 20                                       HED00600
      KSW(4) = 18                                                       HED00700
      GO TO 80                                                          HED00800
   20 IF (KSW(2) .EQ. 0) GO TO 30                                       HED00900
      KSW(4) = 30                                                       HED01000
      GO TO 80                                                          HED01100
   30 KSW(4) = 0                                                        HED01200
      IF (LSW .EQ. 1) KSW(4) = 24                                       HED01300
      GO TO 80                                                          HED01400
   40 KSW(4) = 6                                                        HED01500
      GO TO 80                                                          HED01600
   50 KSW(4) = 12                                                       HED01700
      GO TO 80                                                          HED01800
   60 KSW(4) = 36                                                       HED01900
      GO TO 80                                                          HED02000
   70 KSW(4) = 42                                                       HED02100
   80 RETURN                                                            HED02200
      END                                                               HED02300
```

```
1*              SUBROUTINE  MSFLD, VERSION  5, REVISION 0
2*
3*              SUBROUTINE MSFLD(I1,I2,IWRD,J1,JWRD)                              MSF00100
4*      C       THIS PROG EXTRACTS AN I2 BIT BYTE FROM IWRD STARTING AT BIT I1 ANDMSF00200
5*      C       STORES IT IN JWRD STARTING AT BIT J1. THE REMAINING BITS OF JWRD  MSF00300
6*      C       ARE UNCHANGED. I1 AND J1 ARE COUNTED RIGHT FROM THE SIGN BIT AND  MSF00400
7*      C       THE SIGN BIT IS BIT ZERO.                                         MSF00500
8*              FLD(J1,I2,JWRD) = FLD(I1,I2,IWRD)                                 MSF00600
9*              RETURN                                                            MSF00700
10*             END                                                               MSF00800
```

```
1*          SUBROUTINE  INPTS, VERSION  5, REVISION 0
2*
3*          SUBROUTINE INPTS(KS,IB,NX,II,NY,D,T)                              INP00100
4*          DIMENSION D(41,1),T(1)                                            INP00200
5*          DO 10 I=1,NX                                                      INP00300
6*          KOUT = 4*I-4+KS-IB                                                INP00400
7*          CALL INTOUT(D,KOUT,NY,1,41,I)                                     INP00500
8*       10 CONTINUE                                                          INP00600
9*          IF (KS .LT. 5) GO TO 30                                           INP00700
10*         DO 20 I=1,NX                                                      INP00800
11*         KOUT = 4*I-2                                                      INP00900
12*         CALL INTOUT(T,KOUT,NY,1,1,1)                                      INP01000
13*         DO 20 J=1,NY                                                      INP01100
14*         TMP = 0.0                                                         INP01200
15*         IF (T(J) .LE. 0.0.OR.D(I,J) .LE. 0.0) GO TO 20                    INP01300
16*         TMP = T(J)/D(I,J)                                                 INP01400
17*      20 D(I,J) = TMP                                                      INP01500
18*      30 RETURN                                                            INP01600
19*         END                                                               INP01700
```

```
1*          SUBROUTINE INTOUT, VERSION 6,  REVISION 0
2*
3*          SUBROUTINE INTOUT(D,I,N,L,IDM,K)                                INT00100
4*          DIMENSION D(IDM,1)                                              INT00200
5*          INTEGER RECLTH                                                  INT00300
6*          IF (ISP .NE. 0) GO TO 10                                        INT00400
7*          ISP = 1                                                         INT00500
8*          RECLTH = 41                                                     INT00600
9*          DEFINE FILE 13(164,RECLTH,U,KOUK)                               INT00700
10*       10 CONTINUE                                                       INT00800
11*         KOUK = I                                                        INT00900
12*       60 FORMAT (1X,8I6)                                                INT01000
13*         GO TO (20,30),L                                                 INT01100
14*       20 READ (13'KOUK) (D(K,J),J=1,N)                                  INT01200
15*         GO TO 40                                                        INT01300
16*       30 WRITE (13'KOUK) (D(K,J),J=1,N)                                 INT01400
17*       40 RETURN                                                         INT01500
18*          END                                                            INT01600
```

TABLE OF CONTENTS

Section		Title	Page No.	
		INTRODUCTION	1	1/A4
A		USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM—VERSION 6	3	1/A6
	A.1	Program Input Parameters	3	1/A6
	A.2	Program Input Data Card Sequence	4	1/A7
	A.3	Preprocessor Program Output	12	1/B1
	A.4	Fortran Source Listing for the NASA/MSFC Cloud-Rise Preprocessor Program —Version 6	12	1/B1
B		USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM — VERSION 6	65	2/B11
	B.1	Program Description	65	2/B11
	B.2	Program Input Parameters	66	2/B12
	B.3	Condensed Table of Namelist Input Parameters	90	2/D8
	B.4	Data Input Format	98	2/E9
	B.5	Fortran Source Listing for the NASA/MSFC Multilayer Diffusion Program —Version 6	99	2/E10

```
      SUBROUTINE  BREAK, VERSION 6,  REVISION 0

      SUBROUTINE BREAK(K,XO,YO)                                          BRK00100
      COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,  BRK00200
     1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),      BRK00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),       BRK00400
     3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,      BRK00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),  BRK00600
     5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),BRK00700
     6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)BRK00800
     7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                  BRK00900
      COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),BRK01000
     1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,ST01,     BRK01100
     2ST02,ST03,TKD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,GPWR,  BRK01200
     3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,     BRK01300
     4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,           BRK01400
     5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),        BRK01500
     6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,    BRK01600
     7NYSS,CDAMX(3)                                                     BRK01700
      DIMENSION CON(1),DOS(1),AVCON(1),PASSTM(1),ERFX(1)                BRK01800
      EQUIVALENCE (CON,DEPN),(DOS,DEPN(1,2)),(AVCON,DEPN(1,3)),(PASSTM,DBRK01900
     1EPN(1,4)),(ERFX,ANG(10))                                          BRK02000
      REAL MPWR,L,LAT,LAMBDA                                            BRK02100
      INTEGER TESTNO                                                    BRK02200
C     *** THIS SUBROUTINE CALCULATES DOSAGE,CONCENTRATION AND WASHOUT **BRK02300
C     *** ON A GENERAL GRID WITHIN THE SECTOR DELPHI.                   BRK02400
C     DETERMINE LOCATION OF RECEPTOR RELATIVE TO SOURCE AND WIND        BRK02500
C     DIRECTION                                                         BRK02600
      SUMSX = 0.0                                                       BRK02700
      NSMSX = 0                                                         BRK02800
      CALL COORD(N,KK,X,Y,XO,YO,ASP,XS,1)                               BRK02900
      DOS(J) = 0.0                                                      BRK03000
      CON(J) = 0.0                                                      BRK03100
      IF (NBK .NE. 0.AND.IBOT .LE. KK.AND.KK .LE. ITOP) GO TO 135       BRK03200
      IS = 1                                                            BRK03300
      IF (N .EQ. 9) GO TO 310                                           BRK03400
C                       CALCULATION OF MODELS 1,2,3                     BRK03500
  125 CALL SIGMA(X,KK,1)                                                BRK03600
```

```
      IF (SIGY) 130,130,126                                                    BRK03700
  126 IF (SIGZ .LT. 0.0 .AND. MODLS(KK) .EQ. 3) GO TO 130                      BRK03800
      LAT = Y/SIGY                                                             BRK03900
      LAT = -0.5*LA1*LAT                                                       BRK04000
      IF (LAT .LT. -60.0) GO TO 130                                            BRK04100
      LAT = EXP(LAT)                                                           BRK04200
      PEAKD = Q(KK)/(SQR2P*SIGY*UBAR(KK))                                      BRK04300
      IF (MODLS(KK) .EQ. 3) GO TO 20                                           BRK04400
      PEAKD = PEAKD/(Z(KK+1)-Z(KK))                                            BRK04500
      GO TO 21                                                                 BRK04600
   20 PEAKD = PEAKD/(SQR2P*SIGZ)                                               BRK04700
   21 CONTINUE                                                                 BRK04800
      VER = 0.0                                                                BRK04900
      VREF = 1.0                                                               BRK05000
      IF (MODLS(KK) .NE. 3) GO TO 70                                           BRK05100
      VREF = 0.0                                                               BRK05200
      TMPQ1 = -0.5/(SIGZ*SIGZ)                                                 BRK05300
      A = H-ZZL(K)                                                             BRK05400
      B = H-Z(KK)-Z(KK)+ZZL(K)                                                 BRK05500
      C = B*B                                                                  BRK05600
      C = C*TMPQ1                                                              BRK05700
      A1 = Z(KK+1)-Z(KK)                                                       BRK05800
      IF (C .LT. -30.0) GO TO 70                                               BRK05900
      D = A*A                                                                  BRK06000
      D = D*TMPQ1                                                              BRK06100
      IF (D .LT. -30.0) GO TO 50                                               BRK06200
      VER = EXP(D)                                                             BRK06300
   50 VER = VER+GAMMA(1)*EXP(C)                                                BRK06400
      C = 1.0                                                                  BRK06500
      D = GAMMA(1)                                                             BRK06600
      E = D*D                                                                  BRK06700
      AB = 0.0                                                                 BRK06800
   60 AB = AB+2.0                                                              BRK06900
      TR = AB*A1                                                               BRK07000
      TLIM = TR-B                                                              BRK07100
      TLIM = TLIM*TLIM*TMPQ1                                                   BRK07200
      IF (TLIM .LT. -10.0) GO TO 70                                            BRK07300
      STO1 = TR+A                                                              BRK07400
```


165

```
77*           STO2 = TR-A                                                                    BRK07500
78*           STO3 = TR+B                                                                    BRK07600
79*           VREF = VREF+C*EXP(TLIM)+D*(EXP(STO1*STO1*TMPQ1)+EXP(STO2*STO2*TMPQBRK07700
80*          11))+E*EXP(STO3*STO3*TMPQ1)                                                     BRK07800
81*           C = D                                                                          BRK07900
82*           D = E                                                                          BRK08000
83*           E = E*GAMMA(1)                                                                 BRK08100
84*           GO TO 60                                                                       BRK08200
85*        70 CONTINUE                                                                       BRK08300
86*           TMPQ1 = X/UBAR(KK)                                                             BRK08400
87*           DOS(J) = PEAKD*LAT*(VER+VREF)                                                  BRK08500
88*           IF (DECAY .GT. 0.0) DOS(J) = DOS(J)*EXP(-DECAY*TMPQ1)                          BRK08600
89*           IF (LAMBDA .LE. 0.0.OR.TIM1 .GE. TMPQ1) GO TO 127                              BRK08700
90*           IF (Z(KK) .GT. ZLIM) GO TO 127                                                 BRK08800
91*           AB = EXP(-LAMBDA*(TMPQ1-TIM1))                                                 BRK08900
92*           DOS(J) = DOS(J)*AB                                                             BRK09000
93*       127 CONTINUE                                                                       BRK09100
94*           ANG(1) = UBAR(KK)                                                              BRK09200
95*           SUMSX = SUMSX+SIGX                                                             BRK09300
96*           NSMSX = NSMSX+1                                                                BRK09400
97*           IF (SIGX) 129,129,128                                                          BRK09500
98*       128 CONTINUE                                                                       BRK09600
99*           CON(J) = DOS(J)*UBAR(KK)/(SQR2P*SIGX)                                          BRK09700
100*      129 CONTINUE                                                                       BRK09800
101*      130 IF (IS .EQ. 1) GO TO 310                                                       BRK09900
102*          GO TO 140                                                                      BRK10000
103*      135 IS = 0                                                                         BRK10100
104*          IF (N .NE. 9) GO TO 125                                                        BRK10200
105*    C     CALCULATION OF THE FULL TRANSITION MODEL, MODEL4                               BRK10300
106*      140 DO 200 M=IBOT,ITOP                                                             BRK10400
107*          CALL COORD(N,M,X,Y,XO,YO,ASP,XS,2)                                             BRK10500
108*          IF (N .EQ. 9) GO TO 200                                                        BRK10600
109*          CALL SIGMA(X,M,2)                                                              BRK10700
110*          STO1 = 1.414214*SIGZ                                                           BRK10800
111*          TMPQ1 = 1.0/STO1                                                               BRK10900
112*          IF (SIGYNK) 200,200,147                                                        BRK11000
113*      147 IF (SIGZ) 200,200,148                                                          BRK11100
114*      148 LAT = Y/SIGYNK                                                                 BRK11200
```

```
115*          LAT = -0.5*LAT*LAT                                                BRK11300
116*          IF (LAT .LT. -60.0) GO TO 200                                     BRK11400
117*          XBARX = EXP(LAT)                                                  BRK11500
118*          A = Z(M+1)-ZZL(K)                                                 BRK11600
119*          B = ZZL(K)-Z(M)                                                   BRK11700
120*          C = Z(M+1)+ZZL(K)-Z(IBOT)-Z(IBOT)                                 BRK11800
121*          D = Z(IBOT)+Z(IBOT)-Z(M)-ZZL(K)                                   BRK11900
122*          ERFX(1) = A*TMPG1                                                 BRK12000
123*          ERFX(2) = B*TMPG1                                                 BRK12100
124*          ERFX(3) = C*TMPG1                                                 BRK12200
125*          ERFX(4) = D*TMPG1                                                 BRK12300
126*          CALL ISO(1,4)                                                     BRK12400
127*          STOZ = ERFX(1)+ERFX(2)+GAMMA(1)*(ERFX(3)+ERFX(4))                 BRK12500
128*          S1 = 0.0                                                          BRK12600
129*          S3 = Z(ITOP+1)-Z(IBOT)                                            BRK12700
130*          E = 1.0                                                           BRK12800
131*          F = GAMMA(1)                                                      BRK12900
132*          G = F*F                                                           BRK13000
133*          IFL = 0                                                           BRK13100
134*  150     S1 = S1+2.0                                                       BRK13200
135*          S2 = S1*S3                                                        BRK13300
136*          ERFX(3) = (S2+D)*TMPG1                                            BRK13400
137*          ERFX(4) = (C-S2)*TMPG1                                            BRK13500
138*          IF (IFL .EQ. 0) GO TO 155                                         BRK13600
139*          IF (ERFX(3) .GT. 3.0 .AND. ERFX(4) .LT. -3.0) GO TO 185           BRK13700
140*  155     IFL = 1                                                           BRK13800
141*          ERFX(1) = (S2+B)*TMPG1                                            BRK13900
142*          ERFX(2) = (A-S2)*TMPG1                                            BRK14000
143*          CALL ISO(1,4)                                                     BRK14100
144*          STOZ = STO2+F*(ERFX(1)+ERFX(2))+E*(ERFX(3)+ERFX(4))               BRK14200
145*          ERFX(1) = (S2+A)*TMPG1                                            BRK14300
146*          ERFX(2) = (B-S2)*TMPG1                                            BRK14400
147*          ERFX(3) = (S2+C)*TMPG1                                            BRK14500
148*          ERFX(4) = (D-S2)*TMPG1                                            BRK14600
149*          CALL ISO(1,4)                                                     BRK14700
150*          STOZ = STO2+F*(ERFX(1)+ERFX(2))+G*(ERFX(3)+ERFX(4))               BRK14800
151*          E = F                                                             BRK14900
152*          F = G                                                             BRK15000
```


167

```
153*          G = G*GAMMA(1)                                                    BRK15100
154*          GO TO 150                                                         BRK15200
155*      185 CONTINUE                                                          BRK15300
156*          STO3 = 1.0/(Z(M+1)-Z(M))                                          BRK15400
157*          XBARX = EXP(-.5*(Y/SIGYNK)**2)                                    BRK15500
158*      190 TMPQ2 = X/UBAR(JF)                                                BRK15600
159*          S1 = (G(M)*STO3 /(2.0*SQR2P*UBAR(JF)*SIGYNK))*XBARX*STO2          BRK15700
160*          IF (DECAY .GT. 0.0) S1 = S1*EXP(-DECAY*TMPQ2)                     BRK15800
161*          IF (LAMBDA .LE. 0.0.OR.TIM1.GE.TMPQ2+TAST(ILK-1)) GO TO 195       BRK15900
162*          IF (Z(M) .GT. ZLIM) GO TO 195                                     BRK16000
163*          S1 = S1*EXP(-LAMBDA*(TMPQ2+TAST(ILK-1)-TIM1))                     BRK16100
164*      195 CONTINUE                                                          BRK16200
165*          IF (SIGXNK) 210,210,211                                           BRK16300
166*      210 S2 = 0.0                                                          BRK16400
167*          GO TO 212                                                         BRK16500
168*      211 CONTINUE                                                          BRK16600
169*          S2 = (S1*UBAR(JF)/(SQR2P*SIGXNK))                                 BRK16700
170*      212 CONTINUE                                                          BRK16800
171*          DOS(J) = DOS(J)+S1                                                BRK16900
172*          CON(J) = CON(J)+S2                                                BRK17000
173*          SUMSX = SUMSX+SIGXNK                                              BRK17100
174*          NSMSX = NSMSX+1                                                   BRK17200
175*      200 CONTINUE                                                          BRK17300
176*          ANG(1) = UBAR(JF)                                                 BRK17400
177*      310 CONTINUE                                                          BRK17500
178*          ANG(2) = 0.0                                                      BRK17600
179*          IF (NSMSX .GT. 0) ANG(2) = SUMSX/FLOAT(NSMSX)                     BRK17700
180*          AVCON(J) = 0.0                                                    BRK17800
181*          PASSTM(J) = 0.0                                                   BRK17900
182*          IF (ANG(2) .LE. 0.0) GO TO 311                                    BRK18000
183*          IF (DOS(J) .LE. 0.0) GO TO 311                                    BRK18100
184*          ERFX(1) = 0.0                                                     BRK18200
185*          IF (ANG(2) .GT. 0.0) ERFX(1) = ANG(1)*TIMAV/(2.828427*ANG(2))     BRK18300
186*          CALL ISO(1,1)                                                     BRK18400
187*          AVCON(J) = (DOS(J)/TIMAV)*ERFX(1)                                 BRK18500
188*          PASSTM(J) = 4.3*ANG(2)/ANG(1)                                     BRK18600
189*      311 CONTINUE                                                          BRK18700
190*          RETURN                                                            BRK18800
```

```
191*          END
```

BRK18900

169

```
 1*            SUBROUTINE    SGP, VERSION  5, REVISION 0
 2*
 3*            SUBROUTINE SGP(ZH,N,SIG,IN,IZ,UBHK,X,IBD)                                SGP00100
 4*            COMMON /PARAM1/ TESTNO(12),          ISKIP(15),NXS,NYS,NZS,NDI,NCI,  SGP00200
 5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),G(15),       SGP00300
 6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),        SGP00400
 7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,       SGP00500
 8*           4XLRY,XLRZ,ZZL(40),IZMCL(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),   SGP00600
 9*           5TAST(05),UBOT(05),UTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),SGP00700
10*           6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)SGP00800
11*           7,THETAL(10),GAMMAP(20),NT1,TI(10),NPS,NAMCAS(12)                    SGP00900
12*            COMMON /PARAM2/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),SGP01000
13*           1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SGR2P,L,TH,I,J,KK,ST01,      SGP01100
14*           2ST02,ST03,TKD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,GPWR,   SGP01200
15*           3MPWR,I1,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,      SGP01300
16*           4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,            SGP01400
17*           5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),         SGP01500
18*           6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,     SGP01600
19*           7NYSS,CDAMX(3)                                                       SGP01700
20*            DIMENSION DTHK(21)                                                  SGP01800
21*            EQUIVALENCE (DTHK,XAST)                                             SGP01900
22*            INTEGER TESTNO                                                      SGP02000
23*            REAL MPWR,L,LAMBDA                                                  SGP02100
24*      C     SUBROUTINE SGP CALCULATES SIGENK AND SIGANK WITH OR WITHOUT         SGP02200
25*      C     DESTRUCT IN THE LAYER.                                              SGP02300
26*            GO TO (4,44,64,88),IBL                                              SGP02400
27*          4 S = 0.0                                                             SGP02500
28*            MN = N-1                                                            SGP02600
29*            HHNK = ZH                                                           SGP02700
30*            HHRK = 1.0                                                          SGP02800
31*            IF (N .EQ. 1) GO TO 5                                               SGP02900
32*            HHRK = ZH                                                           SGP03000
33*            HHNK = Z(N+1)                                                       SGP03100
34*          5 SG3 = SIGEK(1)                                                      SGP03200
35*            IF (IN .EQ. 2) SG3 = SIGAP(1)                                       SGP03300
36*            IF (N .LE. 2) GO TO 30                                              SGP03400
37*            DO 25 M=2,MN                                                        SGP03500
38*            IF (IN .EQ. 2) GO TO 10                                             SGP03600
```

```
39*            SG1 = SIGEK(M+1)                                                    SGP03700
40*            SG2 = SIGEK(M)                                                      SGP03800
41*            GO TO 20                                                            SGP03900
42*         10 SG1 = SIGAP(M+1)                                                    SGP04000
43*            SG2 = SIGAP(M)                                                      SGP04100
44*         20 S = S+(SG1+SG2)*(Z(M+1)-Z(M))*0.5                                   SGP04200
45*         25 CONTINUE                                                            SGP04300
46*         30 IF (IN .EQ. 2) GO TO 35                                             SGP04400
47*            SG1 = SIGEK(N+1)                                                    SGP04500
48*            SG2 = SIGEK(N)                                                      SGP04600
49*            PWR = QPWR                                                          SGP04700
50*            GO TO 40                                                            SGP04800
51*         35 SG1 = SIGAP(N+1)                                                    SGP04900
52*            SG2 = SIGAP(N)                                                      SGP05000
53*            PWR = MPWR                                                          SGP05100
54*         40 IF (N .EQ. 1) GO TO 42                                              SGP05200
55*            S = S+(ZH-Z(N))*(((SG1-SG2)/(Z(N+1)-Z(N)))*(ZH-Z(N))+SG2)*0.5       SGP05300
56*         42 SIG = (S+RB11(SG3,PWR,HHNK,ZRK))*RAD/HHRK                           SGP05400
57*            RETURN                                                              SGP05500
58*      C     ENTRY UBARS(ZH,N,IZ,UBHK)                                           SGP05600
59*      C     SUBROUTINE UBARS CALCULATES UBARNK, X NK, Y NK, CAP THETA (ANG)     SGP05700
60*         44 XBARX = 0.0                                                         SGP05800
61*            YBARY(IZ) = 0.0                                                     SGP05900
62*            VV = VS(II)                                                         SGP06000
63*            PWR = PPWR                                                          SGP06100
64*            IF (JF .EQ. 2) VV = VB(II)                                          SGP06200
65*            IF (N .EQ. 1) GO TO 50                                              SGP06300
66*            MN = N-1                                                            SGP06400
67*            DO 45 M=1,MN                                                        SGP06500
68*            S = DTHK(M+1)-DTHK(M)                                               SGP06600
69*            IF (S) 46,45,46                                                     SGP06700
70*         46 CONTINUE                                                            SGP06800
71*            S1 = SIN(DTHK(M+1))-SIN(DTHK(M))                                    SGP06900
72*            S2 = COS(DTHK(M+1))-COS(DTHK(M))                                    SGP07000
73*            S = UBAR(M)*(Z(M+1)-Z(M))/(VV*S)                                    SGP07100
74*            XBARX = XBARX+(S1*S)                                                SGP07200
75*            YBARY(IZ) = YBARY(IZ)+(S2*(-S))                                     SGP07300
76*         45 CONTINUE                                                            SGP07400
```


171

```
 77*          50 TMPQ1 = 1.0/(Z(N+1)-Z(N))                                                    SGP07500
 78*             S = ((DTHK(N+1)-DTHK(N))*TMPQ1)*(ZH-Z(N))+DTHK(N)                            SGP07600
 79*             S1 = SIN(S)-SIN(DTHK(N))                                                     SGP07700
 80*             S2 = COS(S)-COS(DTHK(N))                                                     SGP07800
 81*             IF (N .EQ. 1) GO TO 52                                                       SGP07900
 82*             UBHK = ((UBARK(N+1)-UBARK(N))*TMPQ1)*0.5*(ZH-Z(N))+(0.5*UBARK(N))            SGP08000
 83*             GO TO 54                                                                     SGP08100
 84*          52 UBHK = RB11(UBARK(1),PWR,ZH,ZRK)                                             SGP08200
 85*          54 CONTINUE                                                                     SGP08300
 86*             S = DTHK(N+1)-DTHK(N)                                                        SGP08400
 87*             IF (S) 53,55,53                                                              SGP08500
 88*          53 S = UBHK/(VV*S*TMPQ1)                                                        SGP08600
 89*             XBARX = XBARX+(S1*S)                                                         SGP08700
 90*             YBARY(IZ) = YBARY(IZ)+(S2*(-S))                                              SGP08800
 91*          55 CONTINUE                                                                     SGP08900
 92*             IF (XBARX) 57,56,57                                                          SGP09000
 93*          56 IF (YBARY(IZ)) 57,58,57                                                      SGP09100
 94*          57 ANG(IZ) = ATAN2(YBARY(IZ),XBARX)                                             SGP09200
 95*             GO TO 60                                                                     SGP09300
 96*          58 ANG(IZ) = 0.0                                                                SGP09400
 97*          59 UBARNK(IZ) = UBHK                                                            SGP09500
 98*             SQBAR = 0.0                                                                  SGP09600
 99*             GO TO 62                                                                     SGP09700
100*          60 IF (XBARX) 61,59,61                                                          SGP09800
101*          61 SQBAR = SQRT(XBARX*XBARX+YBARY(IZ)*YBARY(IZ))                                SGP09900
102*             UBARNK(IZ) = SQBAR*VV/ZH                                                     SGP10000
103*          62 CONTINUE                                                                     SGP10100
104*             RETURN                                                                       SGP10200
105*       C     ENTRY DEPSO(X,N,IZ)                                                          SGP10300
106*       C     SUBROUTINE DEPSO CALCULATES ALL OF THE DEPOSITION EQUATION EXCEPT            SGP10400
107*       C     THE LATERAL TERM                                                             SGP10500
108*          64 ZF = ZZL(IZ)                                                                 SGP10600
109*             VV = VS(II)                                                                  SGP10700
110*             GAMMB = GAMMA(II)                                                            SGP10800
111*             XXX = X                                                                      SGP10900
112*             PERK = PERC(II)                                                              SGP11000
113*             IF (JF .EQ. 1) GO TO 165                                                     SGP11100
114*             ZF = HB                                                                      SGP11200
```

```
115*            VV = VB(II)                                                    SGP11300
116*            XXX = X+(SIGZO(N)/SIGENK(IZ))**(1.0/BETANK(IZ))                SGP11400
117*            PERK = PERCB(II)                                               SGP11500
118*        165 XKNK = 0.0                                                     SGP11600
119*            IF (GAMMB .GE. 1.0) GO TO 69                                   SGP11700
120*            S1 = 1.0/(SIGENK(IZ)*XXX**BETANK(IZ))                          SGP11800
121*            S2 = VV*XXX/UBARNK(IZ)                                         SGP11900
122*            S3 = -0.5*S1*S1                                                SGP12000
123*            S4 = BETANK(IZ)*(S2-ZF)-S2                                     SGP12100
124*            S2 = S2-ZF                                                     SGP12200
125*            B = 1.0                                                        SGP12300
126*            XKNK = -S4*EXP(S2*S2*S3)                                       SGP12400
127*            A = 0.0                                                        SGP12500
128*         65 A = A+2.0                                                      SGP12600
129*            S5 = A*Z(N+1)                                                  SGP12700
130*            S6 = S5-S2                                                     SGP12800
131*            S7 = S5+S2                                                     SGP12900
132*            S7 = S7*S7*S3                                                  SGP13000
133*            S6 = S6*S6*S3                                                  SGP13100
134*            IF (A .LE. 2.0) GO TO 66                                       SGP13200
135*            IF (S6 .LT. -10.0.AND.S7 .LT. -10.0) GO TO 67                  SGP13300
136*         66 S5 = S5*BETANK(IZ)                                             SGP13400
137*            XKNK = XKNK+B*((S5+S4)*EXP(S7)+GAMMB*(S5-S4)*EXP(S6))          SGP13500
138*            IF (GAMMB .LE. 0.0) GO TO 67                                   SGP13600
139*            B = B*GAMMB                                                    SGP13700
140*            GO TO 65                                                       SGP13800
141*         67 CONTINUE                                                       SGP13900
142*            XY = (SIGYO(N)/SIGANK(IZ))**(1.0/ALPHNK(IZ))                   SGP14000
143*            SIGYNK = SQRT((SIGANK(IZ)*(X+XY)**ALPHNK(IZ))**2+(SIGENK(IZ)*XXX**SGP14100
144*           1BETANK(IZ)*YBARY(IZ)/ZF)**2)                                   SGP14200
145*            IF (SIGYNK .LE. 0.0) GO TO 69                                  SGP14300
146*            DEP = Q(N)*PERK*(1.0-GAMMB)*S1*XKNK/(6.2831853*SIGYNK*FLOAT(NXCI)*SGP14400
147*           1XXX)                                                           SGP14500
148*         69 CONTINUE                                                       SGP14600
149*            RETURN                                                         SGP14700
150*      C     ENTRY BETAK(ZH,N,IZ)                                           SGP14800
151*      C     SUBROUTINE BETAK CALCULATES  BETA NK AND ALPHA NK              SGP14900
152*         68 S1 = 0.0                                                       SGP15000
```

```
      S2 = 0.0                                                          SGP15100
      IF (N .EQ. 1) GO TO 90                                            SGP15200
      MN = N-1                                                          SGP15300
      DO 70 M=1,MN                                                      SGP15400
      S1 = S1+BETA(M)*(Z(M+1)-Z(M))                                     SGP15500
      S2 = S2+ALPHA(M)*(Z(M+1)-Z(M))                                    SGP15600
   70 CONTINUE                                                          SGP15700
      TMPG1 = 1.0/ZN                                                    SGP15800
      TMPG2 = ZN-Z(N)                                                   SGP15900
      BETANK(IZ) = (S1+BETA(N)*TMPG2)*TMPG1                             SGP16000
      ALPHNK(IZ) = (S2+ALPHA(N)*TMPG2)*TMPG1                            SGP16100
      GO TO 95                                                          SGP16200
   90 BETANK(IZ) = BETA(N)                                              SGP16300
      ALPHNK(IZ) = ALPHA(N)                                             SGP16400
   95 CONTINUE                                                          SGP16500
      RETURN                                                            SGP16600
      END                                                               SGP16700
```

```
      SUBROUTINE  WASHT, VERSION 6,  REVISION 0
*
      SUBROUTINE WASHT                                                  WSH00100
      COMMON /PARAM1/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI, WSH00200
     1NDK,NPTS,NVS,NVD,XX(41),YY(41),Z(16),DELX(15),DELY(15),G(15),     WSH00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),      WSH00400
     3ALPHA(20),BETA(20),ZRR,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,     WSH00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10), WSH00600
     5TAST(05),UBOT(05),UTOP(05),VS(20),PERC(20),ACCUM,VB(20),PERCB(20),WSH00700
     6HD,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)WSH00800
     7,THETAL(10),GAMMAF(20),NTI,TI(10),NPS,NANCAS(12)                  WSH00900
      COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),WSH01000
     1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SGR2P,L,TH,I,J,KK,ST01,    WSH01100
     2ST02,ST03,THD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,GPWR, WSH01200
     3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NUD,NTT,    WSH01300
     4NCCC,NDDD,NTT1,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,          WSH01400
     5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),       WSH01500
     6SIGENK(41),SIGAMK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,   WSH01600
     7NYSS,CDAMA(3)                                                     WSH01700
      DIMENSION WASHOU(41,1)                                            WSH01800
      EQUIVALENCE (DEPN,WASHOU)                                         WSH01900
      EQUIVALENCE (ISW6,SIGENK),(A,SIGENK(2)),(B,SIGENK(3)),(C,SIGENK(4)WSH02000
     1),(D,SIGENK(5)),(E,SIGENK(6)),(G,SIGENK(7))                       WSH02100
      REAL MPWR,L,LAMBDA                                                WSH02200
      INTEGER TESTNO                                                    WSH02300
C     THIS SUBROUTINE CALCULATES PRECIPITATION DEPOSITION - MODEL 5     WSH02400
C   * FOR OUTPUT IN MG/M**2 G(KK) IS IN UNITS OF MILLIGRAMS,            WSH02500
C   * FOR OUTPUT IN PH OF TIME DEPENDENT DEPOSITION G(KK) IS IN UNITS   WSH02600
C     OF  G(KK)= ( G(GRAMS)*(1/(RATE IN/HR))*(1/25.4)*(1/MOLE WT.)*     WSH02700
C                  (1/DURATION HRS) )  THEN DEP IN PH = -LOG10(WASHOU).  WSH02800
C   * FOR OUTPUT IN PH OF MAXIMUM DEP AT EACH POINT G(KK) IS IN UNITS   WSH02900
C     OF  G(KK)= ( G(GRAMS)*(1/(RATE IN/HR))*(1/25.4)*(1/MOLE WT.) )    WSH03000
C         THEN DEP IN PH = -LOG10(WASHOU) WHERE DEP IN PH IS > 0 AND    WSH03100
C         < OR = 14.                                                    WSH03200
C     ALSO LAMBDA CAN BE CALCULATED BY -                                WSH03300
C         LAMBDA = 8.3E-5*((RATE IN/HR)*(2.54 CM/IN)*(10 MM/CM))**.567  WSH03400
C                = 5.2E-4*(RATE MM/HR)**.567  IN UNITS OF (1/SEC)     WSH03500
      C = 1.0                                                           WSH03600
```


175

```
39*           D = 1.0                                                                    WSH03700
40*           E = 1.0                                                                    WSH03800
41*           CALL COORD(N,KK,X,Y,XA(I),YY(J),ASP,XS,1)                                  WSH03900
42*           IF (NBK.NE.0.AND.IBOT.LE.KK.AND.KK.LE.ITOP) GO TO 20                       WSH04000
43*           IF (N .EQ. 9) GO TO 70                                                     WSH04100
44*        10 CALL SIGMA(X,KK,1)                                                         WSH04200
45*           A = UBAR(KK)                                                               WSH04300
46*           B = SIGY                                                                   WSH04400
47*           G = TIM1                                                                   WSH04500
48*           GO TO 30                                                                   WSH04600
49*        20 IF (N .NE. 9) GO TO 10                                                     WSH04700
50*           CALL COORD(N,KK,X,Y,XA(I),YY(J),ASP,XS,2)                                  WSH04800
51*           IF (N .EQ. 9) GO TO 70                                                     WSH04900
52*           CALL SIGMA(X,KK,2)                                                         WSH05000
53*           A = UBAR(JF)                                                               WSH05100
54*           B = SIGYNK                                                                 WSH05200
55*           G = TIM1-TAST(ILK-1)                                                       WSH05300
56*           SIGX = SIGXNK                                                              WSH05400
57*        30 IF (ISKIP(4) .NE. 0) GO TO 35                                              WSH05500
58*           IF (X/A .LT. G) GO TO 70                                                   WSH05600
59*        35 CONTINUE                                                                   WSH05700
60*           IF (B .LE. 0.0) GO TO 70                                                   WSH05800
61*           IF (G .LT. (X-2.15*SIGX)/A) GO TO 40                                       WSH05900
62*           IF (ISKIP(4) .EQ. 1) GO TO 40                                              WSH06000
63*            E = AMOD(YY(J),360.0)                                                     WSH06100
64*           IF (E .LT. 0.0) E = 360.0+E                                                WSH06200
65*           WRITE (6,80) XX(I),E                                                       WSH06300
66*        40 CONTINUE                                                                   WSH06400
67*        50 E = Y/B                                                                    WSH06500
68*           E = -0.5*E*E                                                               WSH06600
69*           IF (E .LT. -60.0) GO TO 70                                                 WSH06700
70*           E = EXP(E)                                                                 WSH06800
71*           IF (ISKIP(4) .EQ. 0) GO TO 55                                              WSH06900
72*     C     MAXIMUM DEP                                                              WSH07000
73*           C = EXP(-LAMBDA*2.15*SIGX/A)                                               WSH07100
74*     C     IF OUTPUT IN PH                                                          WSH07200
75*           IF (ISKIP(9) .NE. 0) C = C*837.209302*A/SIGX                               WSH07300
76*     C     837.209302*A/SIGX=1/DURATION=3600*UBAR/(4.3*SIGX)                        WSH07400
```

```
77*            GO TO 60                                                                    WSH07500
78*         55 CONTINUE                                                                    WSH07600
79*      C     TIME DEPENDENT DEP                                                          WSH07700
80*            C = EXP(-LAMBDA*(X/A-G))                                                    WSH07800
81*         60 WASHOU(I,J) = WASHOU(I,J)+(LAMBDA*Q(KK)/(SQR2P*A*B))*C*E                    WSH07900
82*         70 RETURN                                                                      WSH08000
83*         80 FORMAT (1H0,30H *** PRECIPITATION DEPOSITION AT XX=,F10.3,5H, YY=,WSH08100
84*           1F10.3,26H MAY BE OVER ESTIMATED ***/)                                    WSH08200
85*            END                                                                         WSH08300
```

```
      SUBROUTINE  COORD, VERSION  5, REVISION 0
C
      SUBROUTINE COORD(N,M,X,Y,XO,YO,ASP,XS,ICK)                        CRD00100
      COMMON /PARAMT/ TESTNO(12),       1SKIP(15),NXS,NYS,NZS,NDI,NCI,  CRD00200
     1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),G(15),     CRD00300
     2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),      CRD00400
     3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,     CRD00500
     4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10), CRD00600
     5TMST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),CRD00700
     6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)CRD00800
     7,THETAL(10),GAMMAP(20),NT1,TI(10),NPS,NAMCAS(12)                  CRD00900
      COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),CRD01000
     1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,ST01,    CRD01100
     2ST02,ST03,TRD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR, CRD01200
     3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,    CRD01300
     4NCCC,NDDD,NTT1,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,          CRD01400
     5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),       CRD01500
     6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,   CRD01600
     7NYSS,CDAMX(5)                                                     CRD01700
      INTEGER TESTNO                                                    CRD01800
      REAL MPWR,L,LAMBDA                                                CRD01900
C      *****THIS SUBROUTINE TRANSLATES AND ROTATES THE FIXED INPUT *****CRD02000
C      ***** COORDINATES RELATIVE TO A SYSTEM WITH POSITIVE X AXIS  ****CRD02100
C      ***** ALONG THE WIND DIRECTION THETA.                           CRD02200
      N = 0                                                             CRD02300
      B = AMOD(YO,360.0)*RAD                                            CRD02400
      IF (ICK .EQ. 2) GO TO 10                                          CRD02500
      A = THETA(M)                                                      CRD02600
      GO TO 11                                                          CRD02700
   10 A = THETA(JF)                                                     CRD02800
   11 XP = XO*SIN(B)                                                    CRD02900
      YP = XO*COS(B)                                                    CRD03000
      A = A*RAD                                                         CRD03100
      B = COS(A)                                                        CRD03200
      A = SIN(A)                                                        CRD03300
      DY = DELY(M)*RAD                                                  CRD03400
      DX = DELX(M)*SIN(DY)                                              CRD03500
      DY = DELX(M)*COS(DY)                                              CRD03600
```

```
39*          20 IF (ICK .EQ. 2) GO TO 50                                                    CRD03700
40*          21 X1 = XP-DX                                                                  CRD03800
41*             Y1 = YP-DY                                                                  CRD03900
42*             X = -X1*A-Y1*B                                                              CRD04000
43*             Y = X1*B-Y1*A                                                               CRD04100
44*             IF (X .LE. 0.0) GO TO 80                                                    CRD04200
45*             IF (KSW(2) .EQ. 0) GO TO 40                                                 CRD04300
46*             XS = SQRT(X1*X1+Y1*Y1)                                                      CRD04400
47*             ASP = 0.0                                                                   CRD04500
48*             IF (X1) 31,30,31                                                            CRD04600
49*          30 IF (Y1) 31,90,31                                                            CRD04700
50*          31 ASP = 1.5707963-ATAN2(Y1,X1)                                                CRD04800
51*             IF (ASP .LT. 0.0) ASP = ASP+6.2831853                                       CRD04900
52*             GO TO 90                                                                    CRD05000
53*          40 IF (NBK .EQ. 0) GO TO 90                                                    CRD05100
54*             IF (ICK .EQ. 2) GO TO 90                                                    CRD05200
55*             IF (KK .LT. IBOT.OR.KK .GT. ITOP) GO TO 90                                  CRD05300
56*             IF (XAST(M) .LE. 0.0) GO TO 80                                              CRD05400
57*             ASP = THETA(JF)*RAD                                                         CRD05500
58*          50 XS = (THETA(M)+180.0)*RAD                                                   CRD05600
59*             DX = DX+XAST(M)*SIN(XS)                                                     CRD05700
60*             DY = DY+XAST(M)*COS(XS)                                                     CRD05800
61*             IF (ICK .EQ. 2) GO TO 21                                                    CRD05900
62*             X1 = XP-DX                                                                  CRD06000
63*             Y1 = YP-DY                                                                  CRD06100
64*             XS = -X1*SIN(ASP)-Y1*COS(ASP)                                               CRD06200
65*             A = ABS(THETA(M)-THETA(JF))                                                 CRD06300
66*             IF (A .GE. 180.0) A = 360.0-A                                               CRD06400
67*             IF (A .GT. 45.0) GO TO 60                                                   CRD06500
68*             IF (XS .LE. 0.0) GO TO 90                                                   CRD06600
69*             GO TO 80                                                                    CRD06700
70*          60 CALL SIGMA(XAST(M),M,3)                                                     CRD06800
71*             ASP = A*RAD                                                                 CRD06900
72*             SIGY = 2.15*SQRT((SIGX*SIN(ASP))**2+(SIGY*COS(ASP))**2)                     CRD07000
73*             IF (A .GT. 90.0) GO TO 70                                                   CRD07100
74*             IF (X .GT. XAST(M)+SIGY) GO TO 80                                           CRD07200
75*             IF (XS .LE. 0.0) GO TO 90                                                   CRD07300
76*             IF (X .LT. XAST(M)) GO TO 90                                                CRD07400
```

```
77*          GO TO 80                                                    CRD07500
78*       70 IF (X .LE. XAST(M)+SIGY) GO TO 90                           CRD07600
79*       80 N = 9                                                       CRD07700
80*       90 RETURN                                                      CRD07800
81*          END                                                         CRD07900
```

```
 1*            SUBROUTINE  SIGMA, VERSION  5, REVISION 0
 2*
 3*            SUBROUTINE SIGMA(XP,M,MM)                                                SIG00100
 4*            COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,        SIG00200
 5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),            SIG00300
 6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),             SIG00400
 7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,            SIG00500
 8*           4XLRY,XLRZ,ZZL(40),IAMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),        SIG00600
 9*           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),       SIG00700
10*           6HB,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)      SIG00800
11*           7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                        SIG00900
12*            COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),      SIG01000
13*           1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,STO1,           SIG01100
14*           2STO2,STO3,TKD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,        SIG01200
15*           3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,           SIG01300
16*           4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                 SIG01400
17*           5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),              SIG01500
18*           6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,          SIG01600
19*           7NYSS,CDAMX(3)                                                           SIG01700
20*            INTEGER TESTNO                                                          SIG01800
21*            REAL MPWR,L,LAMBDA                                                      SIG01900
22*      C      ***** THIS SUBROUTINE CALCULATES THE STANDARD DEVIATIONS OF X,Y,ZSIG02000
23*            X = XP                                                                  SIG02100
24*            IF (MM .EQ. 2) X = XAST(M)                                              SIG02200
25*            MMM = 1                                                                 SIG02300
26*            SIGZ = 0.0                                                              SIG02400
27*            SIGY = 0.0                                                              SIG02500
28*            SIGX = 0.0                                                              SIG02600
29*            N = MODLS(M)                                                            SIG02700
30*            GO TO (40,20,30),N                                                      SIG02800
31*         20 SIGY = SIGYO(M)                                                         SIG02900
32*            SIGX = SIGXO(M)                                                         SIG03000
33*            GO TO 220                                                               SIG03100
34*         30 B3 = SIGEP(M)                                                           SIG03200
35*            B4 = BETA(M)                                                            SIG03300
36*         40 A1 = 1.0                                                                SIG03400
37*            A2 = SIGYO(M)                                                           SIG03500
38*            A3 = SIGAP(M)                                                           SIG03600
```


181

```
      A4 = ALPHA(M)                                                    SIG03700
      A5 = DELTHP(M)                                                   SIG03800
      A6 = SIGXO(M)                                                    SIG03900
      L = 0.0                                                          SIG04000
      IF (DELU(M) .LE. 0.0) GO TO 45                                   SIG04100
      L = 0.28*X*DELU(M)/UBAR(M)                                       SIG04200
   45 IF (MM .EQ. 1) GO TO 60                                          SIG04300
      N = 1                                                            SIG04400
      GO TO 50                                                         SIG04500
   50 T1 = (THETA(M)-THETA(JF))*RAD                                    SIG04600
      A1 = 1.0                                                         SIG04700
      T2 = SIN(T1)                                                     SIG04800
      T1 = COS(T1)                                                     SIG04900
      A2 = SQRT((SIGX*T2)**2+(SIGY*T1)**2)                             SIG05000
      A3 = SIGAP(JF)                                                   SIG05100
      A4 = ALPHA(JF)                                                   SIG05200
      A5 = DELTHP(JF)                                                  SIG05300
      A6 = SQRT((SIGX*T1)**2+(SIGY*T2)**2)                             SIG05400
      B3 = SIGEP(JF)                                                   SIG05500
      B4 = BETA(JF)                                                    SIG05600
      L = 0.0                                                          SIG05700
      IF (DELU(JF) .LE. 0.0) GO TO 60                                  SIG05800
      L = 0.28*X*DELU(JF)/UBAR(JF)                                     SIG05900
   60 IF (A4-1.0) 70,80,70                                             SIG06000
   70 A1 = 1.0/A4                                                      SIG06100
      IF (MMM .EQ. 2) GO TO 90                                         SIG06200
      IF (A2-A3*XRY) 80,80,90                                          SIG06300
   80 XY = A2/A3                                                       SIG06400
      GO TO 91                                                         SIG06500
   90 XY = A4*XRY*(A2/(A3*XRY))**A1+XRY*(1.0-A4)                       SIG06600
   91 IF (MMM .EQ. 1) XY = XY-XLRY                                     SIG06700
      IF (XY .LT. 0.0) XY = 0.0                                        SIG06800
      IF (A4-1.0) 110,100,110                                          SIG06900
  100 T1 = A3*(X+XY)                                                   SIG07000
      GO TO 120                                                        SIG07100
  110 T1 = (X+XY-XRY*(1.0-A4))/(XRY*A4)                                SIG07200
      IF (T1 .LE. 0.0) GO TO 125                                       SIG07300
      T1 = A3*XRY*T1**A4                                               SIG07400
```

```
77*         120 T2 = ABS(A5)*X**4.0509052E-3                                                                                    SIG07500
78*             SIGY = SQRT(T1*T1+T2*T2)                                                                                        SIG07600
79*         125 SIGX = SQRT(L*L*.05408329+A6*A6)                                                                                SIG07700
80*             IF (N .EQ. 1) GO TO 220                                                                                         SIG07800
81*             GO TO (150,130),MMM                                                                                             SIG07900
82*         130 IF (B4-1.0) 140,131,140                                                                                         SIG08000
83*         131 XZ = X                                                                                                          SIG08100
84*             GO TO 190                                                                                                       SIG08200
85*         140 T1 = X/XRZ                                                                                                      SIG08300
86*             GO TO 210                                                                                                       SIG08400
87*         150 IF (B4-1.0) 151,160,151                                                                                         SIG08500
88*         151 B1 = 1.0/B4                                                                                                     SIG08600
89*             IF (SIGZO(M)-B3*XRZ) 160,160,170                                                                                SIG08700
90*         160 XZ = SIGZO(M)/B3-XLRZ                                                                                           SIG08800
91*             GO TO 180                                                                                                       SIG08900
92*         170 XZ = B4*XRZ*(SIGZO(M)/(B3*XRZ))**B1-XLRZ+XRZ*(1.0-B4)                                                           SIG09000
93*         180 IF (XZ .LT. 0.0) XZ = 0.0                                                                                       SIG09100
94*             XZ = X+XZ                                                                                                       SIG09200
95*             IF (B4-1.0) 200,190,200                                                                                         SIG09300
96*         190 SIGZ = B3*XZ                                                                                                    SIG09400
97*             GO TO 220                                                                                                       SIG09500
98*         200 T1 = (XZ-XRZ*(1.0-B4))/(B4*XRZ)                                                                                 SIG09600
99*             IF (T1 .LE. 0.0) GO TO 220                                                                                      SIG09700
100*        210 SIGZ = B3*XRZ*T1**B4                                                                                             SIG09800
101*        220 CONTINUE                                                                                                         SIG09900
102*            IF (MM .NE. 2) GO TO 240                                                                                         SIG10000
103*            IF (MMM .EQ. 2) GO TO 230                                                                                        SIG10100
104*            N = 2                                                                                                            SIG10200
105*            X = XP                                                                                                           SIG10300
106*            MMM = 2                                                                                                          SIG10400
107*            GO TO 50                                                                                                         SIG10500
108*        230 SIGANK = SIGX                                                                                                    SIG10600
109*            SIGYNK = SIGY                                                                                                    SIG10700
110*        240 RETURN                                                                                                           SIG10800
111*            END                                                                                                              SIG10900
```

```
1*            SUBROUTINE  TESTR, VERSION  5, REVISION 0
2*
3*             SUBROUTINE TESTR(KTK)                                                    TST00100
4*            COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,        TST00200
5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),G(15),            TST00300
6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),             TST00400
7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,            TST00500
8*           4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),        TST00600
9*           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VP(20),PERCB(20),       TST00700
10*          6HB,ALPHL(05),BETL(05),TAUL,TAUCL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)       TST00800
11*          7,THETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                         TST00900
12*           COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),       TST01000
13*          1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,ST01,           TST01100
14*          2ST02,ST03,TRD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,        TST01200
15*          3MPWR,II,DEP,XBARX,SGBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,           TST01300
16*          4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                 TST01400
17*          5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),              TST01500
18*          6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,          TST01600
19*          7NYSS,CDAMX(3)                                                            TST01700
20*           INTEGER TESTNO                                                           TST01800
21*           REAL MPWR,L,LAMBDA                                                       TST01900
22*     C     THIS SUBROUTINE DETERMINES THE STRUCTURAL CHANGE IN LAYERS FOR           TST02000
23*     C     THE PULL TRANSITION MODEL                                                TST02100
24*           IF (NBK .EQ. 0) GO TO 100                                                TST02200
25*           IF (KTK .EQ. 0) GO TO 50                                                 TST02300
26*           IF (KK .GE. JBOT(ILK)) GO TO 50                                          TST02400
27*           IBOT = JBOT(ILK)                                                         TST02500
28*           ITOP = JTOP(ILK)                                                         TST02600
29*           GO TO 61                                                                 TST02700
30*        50 IF (KK .NE. JBOT(ILK)) GO TO 61                                          TST02800
31*           IBOT = KK                                                                TST02900
32*           ITOP = JTOP(ILK)                                                         TST03000
33*           DO 60 J=IBOT,ITOP                                                        TST03100
34*        60 XAST(J) = UBAR(J)*TAST(ILK)                                              TST03200
35*           ILK = ILK+1                                                              TST03300
36*        61 CONTINUE                                                                 TST03400
37*           KTK = 0                                                                  TST03500
38*       100 CONTINUE                                                                 TST03600
```

```
39*          RETURN
40*          END
```

TST03700
TST03800

```
1*            SUBROUTINE    ISO, VERSION  5, REVISION 0
2*
3*            SUBROUTINE ISO(MR,MT)                                                    ISO00100
4*            COMMON /PARAMT/ TESTNO(12),        ISKIP(15),NXS,NYS,NZS,NDI,NCI,        ISO00200
5*           1NBK,NPTS,NVS,NVB,XX(41),YY(41),Z(16),DELX(15),DELY(15),Q(15),            ISO00300
6*           2UBARK(16),SIGAK(16),SIGEK(16),SIGXO(15),SIGYO(15),SIGZO(15),             ISO00400
7*           3ALPHA(20),BETA(20),ZRK,TIMAV,THETAK(16),TAUK,TAUOK,H,XRY,XRZ,            ISO00500
8*           4XLRY,XLRZ,ZZL(40),IZMOD(15),DECAY,ZLIM,TIM1,LAMBDA,DI(10),CI(10),        ISO00600
9*           5TAST(05),JBOT(05),JTOP(05),VS(20),PERC(20),ACCUR,VB(20),PERCB(20),       ISO00700
10*          6HD,ALPHL(05),BETL(05),TAUL,TAUOL,ZRL,UBARL(10),SIGAL(10),SIGEL(10)       ISO00800
11*          7,IMETAL(10),GAMMAP(20),NTI,TI(10),NPS,NAMCAS(12)                         ISO00900
12*            COMMON /PARAMS/ UBAR(20),SIGAP(20),DELTHP(20),SIGEP(20),THETA(20),      ISO01000
13*           1DELU(20),VER,VREF,PEAKD,SIGZ,SIGY,SIGX,SQR2P,L,TH,I,J,KK,STO1,           ISO01100
14*           2STO2,STO3,TKD,ILK,RAD,NNZ,ITOP,IBOT,XAST(21),SIGXNK,JF,PPWR,QPWR,        ISO01200
15*           3MPWR,II,DEP,XBARX,SQBAR,NXCI,LAT,SIGYNK,GAMMA(20),NCC,NDD,NTT,           ISO01300
16*           4NCCC,NDDD,NTTT,NSW2,MODLS(15),KSW(5),LINES,IM1,MDLS,NWD,                 ISO01400
17*           5YSV(41),YBARY(41),UBARNK(41),BETANK(41),ALPHNK(41),ANG(42),              ISO01500
18*           6SIGENK(41),SIGANK(41),DEPN(41,41),RNG,AZM,IDATE(2),ITIME(2),YT,          ISO01600
19*           7NTSS,CDAMA(5)                                                            ISO01700
20*            DIMENSION ERFX(6)                                                        ISO01800
21*            EQUIVALENCE (ANG(10),ERFX)                                               ISO01900
22*            INTEGER TESTNO                                                           ISO02000
23*            REAL MPWR,L,LAMBDA                                                       ISO02100
24*            DOUBLE PRECISION A6,A7,A8,A9,A10,A11,DTX                                 ISO02200
25*      C     THIS SUBROUTINE EVALUATES ERF(X)                                         ISO02300
26*            DATA A6,A7,A8,A9,A10,A11/.0705230784D0,.0422820123D0,.0092705272D0       ISO02400
27*           1,.0001520143D0,.0002765672D0,.0000430638D0/                              ISO02500
28*            DO 10 M=MR,MT                                                            ISO02600
29*            IN = 0                                                                   ISO02700
30*            IF (ERFX(M) .LT. 0.0) IN = 1                                             ISO02800
31*            ERFX(M) = ABS(ERFX(M))                                                   ISO02900
32*            IF (ERFX(M) .LT. 1.0E-10) GO TO 5                                        ISO03000
33*            IF (ERFX(M) .GT. 5.0) GO TO 6                                            ISO03100
34*            DTX = 1.0D0+ERFX(M)*(A6+ERFX(M)*(A7+ERFX(M)*(A8+ERFX(M)*(A9+ERFX(M       ISO03200
35*           1)*(A10+ERFX(M)*A11))))                                                   ISO03300
36*            ERFX(M) = 1.0D0-(1.0D0/DTX)**16                                          ISO03400
37*            GO TO 7                                                                  ISO03500
38*          5 ERFX(M) = 0.0                                                            ISO03600
```

```
      GO TO 10                                                          IS003700
    6 ERFX(M) = 1.0                                                     IS003800
    7 IF (IN .EQ. 1) ERFX(M) = -ERFX(M)                                 IS003900
   10 CONTINUE                                                          IS004000
      RETURN                                                            IS004100
      END                                                               IS004200
```


187

```
1*            SUBROUTINE    RBB, VERSION  5, REVISION 0
2*
3*            FUNCTION RBB(A,B,C)                                    RBB00100
4*            RBB = ALOG(A/B)*C                                      RBB00200
5*            IF (RBB+1.0) 20,10,20                                  RBB00300
6*         10 RBB = -.99999999                                       RBB00400
7*         20 RBB = RBB+1.0                                          RBB00500
8*            RETURN                                                 RBB00600
9*            END                                                    RBB00700
```

```
1*          SUBROUTINE   RB11, VERSION  5, REVISION 0
2*
3*          FUNCTION RB11(PARM,P,Z,ZRK)                                    Rb100100
4*          Rb11 = PARM*(Z**P-ZRK**P)/(P*(Z-ZRK)*ZRK**(P-1.0))             Rb100200
5*          RETURN                                                         Rb100300
6*          END                                                            Rb100400
```

```
      SUBROUTINE SPLINE, VERSION  5, REVISION 1

      SUBROUTINE SPLINE(X,Y,A,B,C,D,N,IER)                                  SPL00100
      DIMENSION X(1),Y(1),A(1),B(1),C(1),D(1)                               SPL00200
      IER = 0                                                               SPL00300
      C(1) = 0.0                                                            SPL00400
      C(N) = 0.0                                                            SPL00500
      Q = 1.07179677                                                        SPL00600
C     Q = 4.0*(2.0-SQRT(3.0))                                               SPL00700
      NP = N-1                                                              SPL00800
      DO 10 I=1,NP                                                          SPL00900
      A(I) = X(I+1)-X(I)                                                    SPL01000
      B(I) = (Y(I+1)-Y(I))/A(I)                                             SPL01100
      IF (I .LT. 2) GO TO 10                                                SPL01200
      C(I) = 2.0*(B(I)-B(I-1))/(A(I-1)+A(I))                                SPL01300
      D(I) = C(I)*1.5                                                       SPL01400
C     D(I) = C(I)*3.0/2.0                                                   SPL01500
   10 CONTINUE                                                              SPL01600
      NTM = 0                                                               SPL01700
   20 XM = 0.0                                                              SPL01800
      DO 30 I=2,NP                                                          SPL01900
      YP = C(I+1)                                                           SPL02000
      YP = Q*(((YP-C(I-1))/(1.0+A(I)/A(I-1))-YP)*0.5-C(I)+D(I))             SPL02100
      IF (ABS(YP) .GT. XM) XM = ABS(YP)                                     SPL02200
      C(I) = C(I)+YP                                                        SPL02300
   30 CONTINUE                                                              SPL02400
      NTM = NTM+1                                                           SPL02500
      IF (NTM .LT. 60) GO TO 35                                             SPL02600
      IER = 1                                                               SPL02700
      GO TO 36                                                              SPL02800
   35 CONTINUE                                                              SPL02900
      IF (1.0E-3 .LE. XM) GO TO 20                                          SPL03000
   36 CONTINUE                                                              SPL03100
      DO 40 I=1,NP                                                          SPL03200
      A(I) = (C(I+1)-C(I))/A(I)                                             SPL03300
   40 CONTINUE                                                              SPL03400
      RETURN                                                                SPL03500
      END                                                                   SPL03600
```

```
      SUBROUTINE LLPLOT, VERSION 6, REVISION 0
C
      SUBROUTINE LLPLOT(YAR,XAR,N,TITLE,CRIT,NCRIT,NWD,VERTCL,NCV,ZBB,  LLP00100
     1ZIT)                                                              LLP00200
      COMMON /XYXYPT/ YP(41),XP(41),A(41),B(41),C(41),D(41),XI(41),YI(41LLP00300
     1),NUM(3),NC                                                       LLP00400
      COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY, LLP00500
     1XSIZE1,YSIZE1                                                     LLP00600
      DIMENSION XAR(1),YAR(1),LINE(120),TITLE(1),CRIT(1),XF(1),YF(1),   LLP00700
     1FLUX(5),LEXP(5),VERTCL(1)                                         LLP00800
      COMMON /ILALPH/ LCRIT(10),IBLANK,ISTAR,IP1,IP2,IP3,HLABEL(5),NCH  LLP00900
      COMMON /PLTLLO/ ISW,XMAXJN,YMAXJN,XCIZE,YCIZE                     LLP01000
      DATA HLABEL/27HALONGWIND DISTANCE (METERS)/,NCH/27/                LLP01100
      DATA IBLANK/1H /,LCRIT/2HA=,2HB=,2HC=,2HD=,2HE=,2HF=,2HG=,2HH=,2HILLP01200
     1=,2HJ=/,ISTAR/1H*/                                                LLP01300
      EQUIVALENCE (FLUX,HLABEL),(LINE,B),(XF,XI),(YF,YI)                LLP01400
      EQUIVALENCE (XLM1,NND),(YBM1,NST),(HT,IPWRX),(CHARF,IPWRY),(SCLX,FLLP01500
     1II),(SCLY,II),(XSIZE1,IEXP),(YSIZE1,PWRY)                         LLP01600
      DATA LEXP/2H5-,2H2-,2H  /                                         LLP01700
 2010 FORMAT (7X,1H(,20(6H------),1H))                                  LLP01800
 2020 FORMAT (4X,3H10-,1H(,3(11(1H-),1H1,15(1H-),1H1,11(1H-),1H1),1H)/6XLLP01900
     1,3(11,39X),11/6X,3(2H10,11X,1H2,15X,1H5,10X),2H10/54X,5A6)        LLP02000
 2030 FORMAT (1X,A1,3X,A2,1H(,120A1,1H))                                LLP02100
 2040 FORMAT (1X,A1,3X,I2,1H(,120A1,1H))                                LLP02200
 2050 FORMAT (1X,A1,2X,4H10-(,120A1,1H))                                LLP02300
 2060 FORMAT (2(5(10X,A1,1H=,E10.3,1H,)/))                              LLP02400
 2090 FORMAT (86H0 ** NO PLOTS THIS CASE -- DOSAGE OR CONCENTRATION VALULLP02500
     1ES ARE PROBABLY OUT OF RANGE **//)                                LLP02600
C     FIND XMIN, XMAX, YMIN, YMAX                                       LLP02700
      YMAX = -1.E20                                                     LLP02800
      NND = N+1                                                         LLP02900
      NST = 0                                                           LLP03000
    5 NST = NST+1                                                       LLP03100
      IF (NST .GE. N) GO TO 500                                         LLP03200
      IF (XAR(NST) .LE. 0.0 .OR. YAR(NST) .LE. 0.0) GO TO 5             LLP03300
   10 NND = NND-1                                                       LLP03400
      IF (NND .LE. 1) GO TO 500                                         LLP03500
      IF (XAR(NND) .LE. 0.0 .OR. YAR(NND) .LE. 0.0) GO TO 10            LLP03600
```

```
      IF (NND .LE. NST) GO TO 500                                          LLP03700
      DO 15 I=NST,NND                                                      LLP03800
      IF (XAR(I) .LE. 0.0) GO TO 500                                       LLP03900
      XF(I) = XAR(I)                                                       LLP04000
      IF (ISW .NE. 2) XF(I) = ALOG10(XAR(I))                               LLP04100
      IF (YAR(I) .LE. 0.0) GO TO 14                                        LLP04200
      YF(I) = ALOG10(YAR(I))                                               LLP04300
      IF (YMAX .LT. YF(I)) YMAX = YF(I)                                    LLP04400
      GO TO 15                                                             LLP04500
   14 YF(I) = -1.E20                                                       LLP04600
   15 CONTINUE                                                             LLP04700
      IPWRX = INT(XF(NST)+100.0)-100                                       LLP04800
      IPWRY = INT(YMAX+100.0)-102                                          LLP04900
      IF (IPWRX .LT. 2) IPWRX = 2                                          LLP05000
      PWRY = FLOAT(IPWRY)                                                  LLP05100
C     PRINT TITLE INFORMATION.                                             LLP05200
      CALL PRTTIL(NWD,LINES,TITLE,-1.0,0.0,2BB,ZTT)                        LLP05300
      WRITE (6,2010)                                                       LLP05400
C     LOOP FOR 48 PRINTER LINES                                            LLP05500
      JK1 = 0                                                              LLP05600
      JK2 = 1                                                              LLP05700
      JT = 0                                                               LLP05800
      IST = (48-NCV)/2                                                     LLP05900
      DO 220 I=1,48                                                        LLP06000
      IAI = LEXP(3)                                                        LLP06100
      IF (I .LT. IST) GO TO 17                                             LLP06200
      JT = JT+1                                                            LLP06300
      IF (JT .GT. NCV) GO TO 17                                            LLP06400
      JK1 = JK1+1                                                          LLP06500
      IF (JK1 .LT. 7) GO TO 16                                             LLP06600
      JK1 = 1                                                              LLP06700
      JK2 = JK2+1                                                          LLP06800
   16 CALL MSFLD(IABS(6*(JK1-1)),6,VERTCL(JK2),0,IAI)                      LLP06900
   17 CONTINUE                                                             LLP07000
      II=48-I                                                              LLP07100
      FII = FLOAT(II)*0.0625                                               LLP07200
      IF (NCRIT) 60,60,20                                                  LLP07300
   20 IF (NCRIT .EQ. 9) GO TO 60                                           LLP07400
```

```
77*          DO 40 KK=1,NCRIT                                                    LLP07500
78*          IF (CRIT(KK) .LE. 0.0) GO TO 40                                     LLP07600
79*          IF (ABS(ALOG10(CRIT(KK))-FII-PWRY) .GT. 0.031255) GO TO 40          LLP07700
80*          DO 30 LL=1,120                                                      LLP07800
81*       30 LINE(LL) = LCRIT(KK)                                                LLP07900
82*          GO TO 67                                                            LLP08000
83*       40 CONTINUE                                                            LLP08100
84*       60 DO 65 J=1,120                                                       LLP08200
85*       65 LINE(J) = IBLANK                                                    LLP08300
86*       67 DO 70 J=NST,NND                                                     LLP08400
87*          IF (ABS(YF(J)-FII-PWRY) .GT. 0.031255) GO TO 70                     LLP08500
88*          L = INT(XF(J)*40.0+0.5)-40*IPWRX                                    LLP08600
89*          IF (L .LT. 1 .OR. L .GT. 120) GO TO 70                              LLP08700
90*          LINE(L)=ISTAR                                                       LLP08800
91*       70 CONTINUE                                                            LLP08900
92*          IF (15-I) 90,80,90                                                  LLP09000
93*       80 IEXP=IPWRY+2                                                        LLP09100
94*          GO TO 130                                                           LLP09200
95*       90 IF (31-I) 110,100,110                                               LLP09300
96*      100 IEXP=IPWRY+1                                                        LLP09400
97*          GO TO 130                                                           LLP09500
98*      110 IF (47-I) 140,120,140                                               LLP09600
99*      120 IEXP=IPWRY                                                          LLP09700
100*     130 IF (I .GT. 1) WRITE (6,2040) IAI,IEXP,LINE                          LLP09800
101*         GO TO 220                                                           LLP09900
102*     140 IF (16-I) 150,170,150                                               LLP10000
103*     150 IF (32-I) 160,170,160                                               LLP10100
104*     160 IF (48-I) 175,170,175                                               LLP10200
105*     170 IF (I .EQ. 1) GO TO 220                                             LLP10300
106*         IF (I .EQ. 48) GO TO 171                                            LLP10400
107*         WRITE (6,2050) IAI,LINE                                             LLP10500
108*         GO TO 220                                                           LLP10600
109*     171 IP1 = IPWRX+1                                                       LLP10700
110*         IP2 = IPWRX+2                                                       LLP10800
111*         IP3 = IPWRX+3                                                       LLP10900
112*         WRITE (6,2020) IPWRX,IP1,IP2,IP3,FLDX                               LLP11000
113*         GO TO 220                                                           LLP11100
114*     175 IEXP = 3                                                            LLP11200
```

```
     IF (MOD(I,10) .NE. 5) GO TO 180                                          LLP11300
     IEXP = 1                                                                 LLP11400
     GO TO 190                                                                LLP11500
100  IF (MOD(I,10) .EQ. 11) IEXP = 2                                          LLP11600
190  IF (I .GT. 1) WRITE (6,2030) IAI,LEXP(IEXP),LINE                         LLP11700
220  CONTINUE                                                                 LLP11800
     IF (NCRIT .GT. 0.AND.NCRIT .LT. 9) WRITE (6,2080) (LCRIT(I),CRIT(ILLP11900
    1),I=1,NCRIT)                                                             LLP12000
370  RETURN                                                                   LLP12100
500  WRITE(6,2090)                                                            LLP12200
     RETURN                                                                   LLP12300
     END                                                                      LLP12400
```

194

```
1*            SUBROUTINE ISSOPT, VERSION 6,  REVISION 0
2*
3*            SUBROUTINE ISSOPT(X,Y,NX,NY,FI,LEGEND,NCHAR,DP,NYS,XX,DR,II,IREC,YISS00100
4*           1T,ISW3,KLINE,NCV,JM,DECAY,LAMBDA,ZB,ZT)                          ISS00200
5*            COMMON /PLTISU/ SCL,XMAXIN,YMAXIN,XSIZE,YSIZE,RASTIN,JSW         ISS00300
6*            COMMON /BNDS/ XRIT,XLFT,YBOT,YTOP,XPL,YPL                        ISS00400
7*            DIMENSION X(1),Y(1),FI(1),DP(41,1),XX(1),DR(245,1),NPP(4),YY(1)  ISS00500
8*            DIMENSION TLABEL(3)                                              ISS00600
9*            DIMENSION LEGEND(1),KLINE(1)                                     ISS00700
10*           REAL LAMBDA                                                      ISS00800
11*           DIMENSION KB(4)                                                  ISS00900
12*           COMMON /XYXYPT/ YP(41),XP(41),A(41),B(41),C(41),D(41),XI(41),YI(41ISS01000
13*          1),NUM(3),NC                                                      ISS01100
14*           EQUIVALENCE (YP,YY)                                              ISS01200
15*           DATA XLM,YBM,XRM,YTM,LISP/62.,102.,24.,22.,3./                   ISS01400
16*           DATA RADI/57.295779/                                             ISS01500
17*           DATA TLABEL/17HDISTANCE (METERS)/,NCTH/17/                       ISS01600
18*           COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY, ISS01700
19*          1XSIZE1,YSIZE1                                                    ISS01800
20*           COMMON /ILALPH/ LCRIT(10),IBLANK,ISTAR,IP1,IP2,IP3,HLABEL(5),NCH ISS01900
21*           DATA RAD/.017453293/                                             ISS02000
22*           XYTERP(A,B,C,D,E) = B-(D-E)*(B-A)/(D-C)                          ISS02100
23*           NWD = NCHAR/6                                                    ISS02200
24*           IF (ISW3 .EQ. 1) GO TO 50                                        ISS02300
25*           XLM1 = XLM                                                       ISS02400
26*           YBM1 = YBM                                                       ISS02500
27*           XRM1 = XRM                                                       ISS02600
28*           YTM1 = YTM                                                       ISS02700
29*           XSIZE1 = XSIZE                                                   ISS02800
30*           YSIZE1 = YSIZE                                                   ISS02900
31*           ISW = 1                                                          ISS03000
32*     C     DETERMINE MAX AND MIN FOR BOTH AXES                              ISS03100
33*           DO 10 I=1,NX                                                     ISS03200
34*           DO 10 J=1,NYS                                                    ISS03300
35*           DO 10 K=1,NY                                                     ISS03400
36*           IF (DP(I,J) .GT. FI(K)) GO TO 11                                 ISS03500
37*        10 CONTINUE                                                         ISS03600
38*           II = NCHAR/6+1                                                   ISS03700
```

```
      PRINT 2004, (LEGEND(I),I=1,I1)                                    ISS03800
      GO TO 800                                                         ISS03900
   11 CONTINUE                                                          ISS04000
      XMX = X(NX-2)                                                     ISS04100
      IF (XMAXIN .GT. 0.0) XMX = XMAXIN                                 ISS04200
      XMAX = 0.0                                                        ISS04300
      XMIN = 0.0                                                        ISS04400
      YMAX = 0.0                                                        ISS04500
      YMIN = 0.0                                                        ISS04600
      X1(1) = XMX*SIN(YT*RAD)                                           ISS04700
      Y1(1) = XMX*COS(YT*RAD)                                           ISS04800
      YPL = 1.0E8                                                       ISS04900
      DO 12 N=1,NY                                                      ISS05000
   12 YPL = AMIN1(YPL,FI(N))                                            ISS05100
      I1 = 0                                                            ISS05200
      I2 = 0                                                            ISS05300
      DO 15 J=1,NYS                                                     ISS05400
      DO 14 I=1,NX                                                      ISS05500
      IF (DP(I,J) .LT. YPL) GO TO 14                                    ISS05600
      IF (I1 .GT. 0) GO TO 13                                           ISS05700
      I1 = I                                                            ISS05800
   13 I2 = 1                                                            ISS05900
   14 CONTINUE                                                          ISS06000
      IF (I1 .GT. 0) GO TO 16                                           ISS06100
   15 CONTINUE                                                          ISS06200
   16 J1 = J                                                            ISS06300
      I3 = 0                                                            ISS06400
      I4 = 0                                                            ISS06500
      DO 19 J=1,NYS                                                     ISS06600
      DO 18 I=1,NX                                                      ISS06700
      IF (DP(I,NYS-J+1) .LT. YPL) GO TO 18                              ISS06800
      IF (I3 .GT. 0) GO TO 17                                           ISS06900
      I3 = 1                                                            ISS07000
   17 I4 = 1                                                            ISS07100
   18 CONTINUE                                                          ISS07200
      IF (I3 .GT. 0) GO TO 20                                           ISS07300
   19 CONTINUE                                                          ISS07400
   20 J2 = NYS-J+1                                                      ISS07500
```

```
77*          IF (I1 .EQ. 0) I1 = 1                                          ISS07600
78*          IF (I2 .EQ. 0) I2 = NX-2                                       ISS07700
79*          IF (I3 .EQ. 0) I3 = 1                                          ISS07800
80*          IF (I4 .EQ. 0) I4 = NX-2                                       ISS07900
81*          IF (I2 .GT. NX-2) I2 = NX-2                                    ISS08000
82*          IF (I4 .GT. NX-2) I4 = NX-2                                    ISS08100
83*          Y1 = Y(J1)                                                     ISS08200
84*          Y2 = Y(J2)                                                     ISS08300
85*          IF (YMAXIN .LE. 0.0) GO TO 21                                  ISS08400
86*          XPL = 1.0-YMAXIN/(2.0*XMX*XMX)                                 ISS08500
87*          IF (XPL .GT. 1.0) XPL = 1.0                                    ISS08600
88*          IF (XPL .LT. -1.0) XPL = -1.0                                  ISS08700
89*          XPL = ACOS(XPL)*RAD1                                           ISS08800
90*          Y1 = YT+0.5*XPL                                                ISS08900
91*          Y2 = YT-0.5*XPL                                                ISS09000
92*       21 X1(2) = X(I1)*SIN(Y1*RAD)                                      ISS09100
93*          Y1(2) = X(I1)*COS(Y1*RAD)                                      ISS09200
94*          X1(3) = X(I3)*SIN(Y2*RAD)                                      ISS09300
95*          Y1(3) = X(I3)*COS(Y2*RAD)                                      ISS09400
96*          X1(4) = X(I2)*SIN(Y1*RAD)                                      ISS09500
97*          Y1(4) = X(I2)*COS(Y1*RAD)                                      ISS09600
98*          X1(5) = X(I4)*SIN(Y2*RAD)                                      ISS09700
99*          Y1(5) = X(I4)*COS(Y2*RAD)                                      ISS09800
100*         DO 22 I=1,5                                                    ISS09900
101*         XMAX = AMAX1(XMAX,X1(I))                                       ISS10000
102*         YMAX = AMAX1(YMAX,Y1(I))                                       ISS10100
103*         XMIN = AMIN1(XMIN,X1(I))                                       ISS10200
104*      22 YMIN = AMIN1(YMIN,Y1(I))                                       ISS10300
105*      C  DETERMINE PLOT SCALE                                           ISS10400
106*         IF (SCL .LE. 0.0) GO TO 23                                     ISS10500
107*         SCLX = 12.0/(SCL*.3048)                                        ISS10600
108*         SCLX = SCLX*RASTIN                                             ISS10700
109*         SCLY = SCLX                                                    ISS10800
110*         GO TO 24                                                       ISS10900
111*      23 SCLX = XSIZE1/(XMAX-XMIN)                                      ISS11000
112*         SCLY = YSIZE1/(YMAX-YMIN)                                      ISS11100
113*         SCLX = AMIN1(SCLX,SCLY)                                        ISS11200
114*         SCLY = SCLX                                                    ISS11300
```

```
*115*          24 XPL = XSIZE1/SCLX                                                    ISS11400
*116*             IF (XPL-XMAX+XMIN) 25,26,25                                          ISS11500
*117*          25 XPL = (XPL-XMAX+XMIN)*0.5                                            ISS11600
*118*             XMAX = XMAX + XPL                                                    ISS11700
*119*             XMIN = XMIN-XPL                                                      ISS11800
*120*          26 YPL = YSIZE1/SCLY                                                    ISS11900
*121*             IF (YPL-YMAX+YMIN) 27,28,27                                          ISS12000
*122*          27 YPL = (YPL-YMAX+YMIN)*0.5                                            ISS12100
*123*             YMAX = YMAX+YPL                                                      ISS12200
*124*             YMIN = YMIN-YPL                                                      ISS12300
*125*          28 CONTINUE                                                             ISS12400
*126*             HT = 12                                                              ISS12500
*127*             CHARF = 8                                                            ISS12900
*128*             CALL SETMIV(0,0,0,0)                                                 ISS13100
*129*             CALL FRAMEV(0)                                                       ISS13200
*130*             CALL IDPLOT(XSIZE1+XLM1+XRM1,YSIZE1+YTM1+YBM1)                       ISS13300
*131*       C     DRAW AXES                                                            ISS13400
*132*             CALL ILAXES(1,TLABEL,TLABEL,NCTH,NCTH,LEGEND,NCHAR)                  ISS13500
*133*             XRIT = XMAX                                                          ISS13600
*134*             XLFT = XMIN                                                          ISS13700
*135*             YBOT = YMIN                                                          ISS13800
*136*             YTOP = YMAX                                                          ISS13900
*137*          50 CONTINUE                                                             ISS14000
*138*             LINES = 57                                                           ISS14100
*139*             RMN = 1.0E9                                                          ISS14200
*140*             TMN = YT                                                             ISS14300
*141*             DO 710 N=1,NY                                                        ISS14400
*142*             IF (N .EQ. 1) GO TO 240                                              ISS14500
*143*             DO 230 I=1,NX                                                        ISS14600
*144*             KOUT = 4*I-4+IREC                                                    ISS14700
*145*             CALL INTOUT(DP,KOUT,NYS,1,41,1)                                      ISS14800
*146*         230 CONTINUE                                                             ISS14900
*147*         240 CONTINUE                                                             ISS15000
*148*             CALL NMBRS(FI(N),NUM,NC)                                             ISS15100
*149*             DO 400 I=1,4                                                         ISS15200
*150*         400 NFP(I) = 0                                                           ISS15300
*151*             NP = 3                                                               ISS15400
*152*             L = 0                                                                ISS15500
```

```
      K = 1                                                                    ISS15600
C     CALC POINTS WHERE ISOPLETHS CROSS AXES                                   ISS15700
      DO 470 I=1,NX                                                            ISS15800
      JB = 0                                                                   ISS15900
      DO 430 J=2,NYS                                                           ISS16000
      IF (DP(I,J-1) .LE. FI(N).AND.FI(N) .LE. DP(I,J)) GO TO 410               ISS16100
      IF (DP(I,J-1) .GE. FI(N).AND.FI(N) .GE. DP(I,J)) GO TO 410               ISS16200
      GO TO 430                                                                ISS16300
  410 JB = 1                                                                   ISS16400
      L = L+1                                                                  ISS16500
      NP = NP+1                                                                ISS16600
      Y2 = Y(J)                                                                ISS16700
      IF (ABS(Y(J-1)-Y2) .LT. 180.0) GO TO 420                                 ISS16800
      Y2 = 360.0-ABS(Y(J-1)-Y2)+Y(J-1)                                         ISS16900
  420 YY(NP) = XYIERP(Y(J-1),Y2,DP(I,J-1),DP(I,J),FI(N))                       ISS17000
      XA(NP) = X(I)                                                            ISS17100
      IF (NP .GE. 245) GO TO 475                                               ISS17200
  430 CONTINUE                                                                 ISS17300
      IF (JB .EQ. 1) GO TO 440                                                 ISS17400
      IF (L .EQ. 0) GO TO 440                                                  ISS17500
      NPP(K) = L                                                               ISS17600
      L = 0                                                                    ISS17700
      K = K+1                                                                  ISS17800
      IF (K .GT. 2) GO TO 475                                                  ISS17900
  440 IF (I .EQ. NX) GO TO 470                                                 ISS18000
      DO 460 J=1,NYS                                                           ISS18100
      IF (DP(I,J) .LE. FI(N).AND.FI(N) .LE. DP(I+1,J)) GO TO 450               ISS18200
      IF (DP(I,J) .GE. FI(N).AND.FI(N) .GE. DP(I+1,J)) GO TO 450               ISS18300
      GO TO 460                                                                ISS18400
  450 L = L+1                                                                  ISS18500
      NP = NP+1                                                                ISS18600
      XA(NP) = XYIERP(X(I),X(I+1),DP(I,J),DP(I+1,J),FI(N))                     ISS18700
      YY(NP) = Y(J)                                                            ISS18800
      IF (NP .GE. 245) GO TO 475                                               ISS18900
  460 CONTINUE                                                                 ISS19000
  470 CONTINUE                                                                 ISS19100
  475 CONTINUE                                                                 ISS19200
      NP = NP-3                                                                ISS19300
```

```
      NPP(K) = L                                                        ISS19400
  480 IF (NPP(K) .GT. 1) GO TO 490                                      ISS19500
      K = K-1                                                           ISS19600
      IF (K .LE. 0) GO TO 710                                           ISS19700
      GO TO 480                                                         ISS19800
  490 CONTINUE                                                          ISS19900
C     DETERMINE IF CLOSED CURVE OR NO, KB(L)=0 IS YES, KB(L) NOT 0 IS NOISS20000
      IP1 = 3                                                           ISS20100
      KC = 0                                                            ISS20200
      DO 496 L=1,K                                                      ISS20300
      KB(L) = 0                                                         ISS20400
      MP = NPP(L)                                                       ISS20500
      J2 = 1                                                            ISS20600
      DO 495 I2=1,2                                                     ISS20700
      I = 0                                                             ISS20800
  491 I = I+1                                                           ISS20900
      IF (I .GT. MP) GO TO 495                                          ISS21000
      IF (YY(I+IP1)-Y(J2)) 491,492,491                                  ISS21100
  492 X1 = 1.0E6                                                        ISS21200
      DO 493 J=1,MP                                                     ISS21300
      IF (J+IP1 .EQ. I+IP1) GO TO 493                                   ISS21400
      Y1 = ABS(Y(J2)-YY(J+IP1))                                         ISS21500
      IF (Y1 .GT. 180.0) Y1 = 360.0-Y1                                  ISS21600
      IF (Y1 .GE. X1) GO TO 493                                         ISS21700
      X1 = Y1                                                           ISS21800
      J1 = J                                                            ISS21900
  493 CONTINUE                                                          ISS22000
      IF (XX(I+IP1) .GT. XX(J1+IP1)) GO TO 494                          ISS22100
      KC = KC+3                                                         ISS22200
      KB(L) = KB(L)+3                                                   ISS22300
      GO TO 491                                                         ISS22400
  494 KB(L) = KB(L)+1                                                   ISS22500
      KC = KC+1                                                         ISS22600
      GO TO 491                                                         ISS22700
  495 J2 = NYS                                                          ISS22800
      IP1 = IP1+NPP(L)                                                  ISS22900
  496 CONTINUE                                                          ISS23000
  497 IF (KC .EQ. 0) GO TO 503                                          ISS23100
```

```
      J = 1
  498 IF (KB(J) .NE. 0) GO TO 499                                                    ISS23200
C     FIRST CLOSED CURVE                                                           ISS23300
      IF (J+1 .GT. K) GO TO 503                                                    ISS23400
      IF (KB(J+1) .EQ. 0) GO TO 502                                                ISS23500
C     CAN SECOND CURVE BE CLOSED                                                   ISS23600
      IF (KB(J+1).EQ.4.OR.KB(J+1).EQ.5.OR.KB(J+1).EQ.7) KB(J+1) = 0                ISS23700
      GO TO 502                                                                    ISS23800
  499 IF (J+1 .GT. K) GO TO 500                                                    ISS23900
      IF (KB(J+1) .NE. 0) GO TO 501                                                ISS24000
C     SECOND CURVE CLOSED                                                          ISS24100
C     CAN FIRST CURVE BE CLOSED                                                    ISS24200
  500 IF (KB(J).EQ.4.OR.KB(J).EQ.5.OR.KB(J).EQ.7) KB(J) = 0                       ISS24300
      IF (K .EQ. 1.AND.KB(1) .EQ. 6) KB(1) = 0                                     ISS24400
      GO TO 502                                                                    ISS24500
C     CAN TWO CURVES BE JOINED INTO ONE CLOSED CURVE                               ISS24600
  501 IF (KB(J) .NE. 2.AND.KB(J) .NE. 4) GO TO 502                                 ISS24700
      IF (KB(J+1) .NE. 6.AND.KB(J+1) .NE. 4) GO TO 502                             ISS24800
C     JOIN TWO CURVES INTO ONE CLOSED CURVE                                        ISS24900
      NPP(J) = NPP(J)+NPP(J+1)                                                     ISS25000
      KB(J) = 0                                                                    ISS25100
      K = K-1                                                                      ISS25200
      J = J+1                                                                      ISS25300
      IF (J .GT. K) GO TO 503                                                      ISS25400
      KB(J) = KB(J+1)                                                              ISS25500
      NPP(J) = NPP(J+1)                                                            ISS25600
      IF (J+1 .GT. 3) GO TO 498                                                    ISS25700
      KB(J+1) = KB(J+2)                                                            ISS25800
      NPP(J+1) = NPP(J+2)                                                          ISS25900
      GO TO 498                                                                    ISS26000
  502 J = J+2                                                                      ISS26100
      IF (J .LE. K) GO TO 498                                                      ISS26200
  503 CONTINUE                                                                     ISS26300
      IF1 = 3                                                                      ISS26400
C     LOOP OVER SEPERATE CURVES OF SAME ISOPLETH                                   ISS26500
      DO 700 L=1,K                                                                 ISS26600
      NP = NPP(L)                                                                  ISS26700
C     SHIFT POINTS TO START OF ARRAY                                               ISS26800
                                                                                   ISS26900
```


201

```
      I = 0                                                                    ISS27000
      DIF = 1.0E20                                                             ISS27100
      DO 520 J=1,NP                                                            ISS27200
      I = I+1                                                                  ISS27300
      XX(I) = XX(J+IP1)                                                        ISS27400
      YY(I) = YY(J+IP1)                                                        ISS27500
      IF (XX(I) .GE. DIF) GO TO 520                                            ISS27600
      DIF = XX(I)                                                              ISS27700
      YRM = YY(I)                                                              ISS27800
  520 CONTINUE                                                                 ISS27900
      IF (L .GT. 1.OR.KB(L) .NE. 0) GO TO 530                                  ISS28000
      IF (DIF .LE. RMN) GO TO 525                                              ISS28100
      NP = NP+1                                                                ISS28200
      DIF = 0.75*RMN                                                           ISS28300
      YRM = TMN                                                                ISS28400
      XX(NP) = DIF                                                             ISS28500
      YY(NP) = YRM                                                             ISS28600
      GO TO 530                                                                ISS28700
  525 RMN = DIF                                                                ISS28800
      TMN = YRM                                                                ISS28900
  530 CONTINUE                                                                 ISS29000
C     DETERMINE CENTRAL POINT OF CURVE AND CONVERT POINTS TO SYSTEM            ISS29100
C     RELATIVE TO CENTRAL POINT                                                ISS29200
      CALL CALCS(XX,YY,NP,RAD,RADI,XSHFT,YSHFT,0.0,0.0,0,KB(L),YT,X,NX)        ISS29300
C     FIND START POINT OF CURVE                                                ISS29400
      YRM = YT                                                                 ISS29500
      NP = 0                                                                   ISS29600
      IF (KB(L) .NE. 0) GO TO 560                                              ISS29700
      YRM = YT+180.0                                                           ISS29800
C     DETERMINE FIRST POINT OF CLOSED CURVE                                    ISS29900
  550 IF (YRM .LE. YY(NP)) GO TO 551                                           ISS30000
      YRM = YRM-360.0                                                          ISS30100
      GO TO 550                                                                ISS30200
  551 IF (YRM .GE. YY(1)) GO TO 552                                            ISS30300
      YRM = YRM+360.0                                                          ISS30400
      GO TO 551                                                                ISS30500
  552 X1 = YRM+180.0                                                           ISS30600
      DO 553 I=1,NP                                                            ISS30700
```

```
      IF (YY(I) .LT. YRM) GO TO 553                                     ISS30800
      MP = I-1                                                          ISS30900
      GO TO 555                                                         ISS31000
  553 CONTINUE                                                          ISS31100
  554 X1 = YRM-180.0                                                    ISS31200
  555 CONTINUE                                                          ISS31300
      GO TO 570                                                         ISS31400
  560 CONTINUE                                                          ISS31500
C     DETERMINE FIRST POINT OF OPENED CURVE                             ISS31600
      DIF = -1.0E9                                                      ISS31700
      DO 561 I=2,NP                                                     ISS31800
      Y1 = ABS(YY(I)-YY(I-1))                                           ISS31900
      IF (Y1 .GT. 160.0) Y1 = 360.0-Y1                                  ISS32000
      IF (Y1 .LT. DIF) GO TO 561                                        ISS32100
      DIF = Y1                                                          ISS32200
      MP = I-1                                                          ISS32300
  561 CONTINUE                                                          ISS32400
      Y1 = ABS(YY(NP)-YY(1))                                            ISS32500
      IF (Y1 .GT. 160.0) Y1 = 360.0-Y1                                  ISS32600
      IF (Y1 .LT. DIF) GO TO 570                                        ISS32700
      MP = 0                                                            ISS32800
  570 CONTINUE                                                          ISS32900
      IF (MP .LE. 0) GO TO 594                                          ISS33000
      DO 572 J=1,MP                                                     ISS33100
      XPL = XX(1)                                                       ISS33200
      YPL = YY(1)                                                       ISS33300
      DO 571 I=2,NP                                                     ISS33400
      XX(I-1) = XX(I)                                                   ISS33500
  571 YY(I-1) = YY(I)                                                   ISS33600
      XX(NP) = XPL                                                      ISS33700
      YY(NP) = YPL                                                      ISS33800
  572 CONTINUE                                                          ISS33900
C     MAKE SURE IN ASCENDING ORDER                                      ISS34000
      Y1 = YY(1)                                                        ISS34100
      DO 593 I=2,NP                                                     ISS34200
      DIF = ABS(YY(I)-Y1)                                               ISS34300
      IF (DIF .GT. 180.0) DIF = 360.0-DIF                               ISS34400
      Y1 = YY(I)                                                        ISS34500
```

```
      593 YY(I) = YY(I-1)+DIF                                                    ISS34600
      594 CONTINUE                                                               ISS34700
          IF (KB(L) .NE. 0) GO TO 595                                            ISS34800
          NP = NP+1                                                              ISS34900
          XX(NP) = XX(1)                                                         ISS35000
          DIF = ABS(YY(1)-YY(NP-1))                                              ISS35100
          IF (DIF .GT. 180.0) DIF = 360.0-DIF                                    ISS35200
          YY(NP) = YY(NP-1)+DIF                                                  ISS35300
      595 CONTINUE                                                               ISS35400
          IF (NP .GT. 245) NP = 245                                              ISS35500
          IF (KB(L) .NE. 0) X1 = 0.5*(YY(1)+YY(NP))                             ISS35600
          NPI = NP                                                               ISS35700
          IER = 1                                                                ISS35800
          DO 600 I =1,NP                                                         ISS35900
      600 XX(I) = ALOG(XX(I))                                                    ISS36000
          IF (NP .LT. 6) GO TO 650                                               ISS36100
          IF (JSW .NE. 0) GO TO 650                                              ISS36200
C         CALC SPLINE COEFFICIENTS WITH RANGE AS AMPLITUDE AND ANGLE AS THE      ISS36300
C         ABSCISSA                                                               ISS36400
          CALL SPLINE(YY,XX,DR,DR(1,2),DR(1,3),DR(1,4),NP,IER)                   ISS36500
          IF (IER .EQ. 1) GO TO 650                                              ISS36600
          XPL = (YY(NP)-YY(1))/200.0                                             ISS36700
          XPL2 = XPL*0.1                                                         ISS36800
          XP1 = XPL                                                              ISS36900
          J = 0                                                                  ISS37000
          M = 1                                                                  ISS37100
          YPL = YY(1)-XP1                                                        ISS37200
      631 YPL = YPL+XP1                                                          ISS37300
          IF (YPL .LE. X1-2.0*XPL) GO TO 632                                     ISS37400
          XP1 = XPL2                                                             ISS37500
          IF (YPL .GE. X1+2.0*XPL) XP1 = XPL                                     ISS37600
      632 IF (YPL .LT. YY(M+1)) GO TO 634                                        ISS37700
      633 M = M+1                                                                ISS37800
          IF (M .GE. NP) GO TO 670                                               ISS37900
          IF (YPL .GE. YY(M+1)) GO TO 633                                        ISS38000
      634 Y1 = YPL-YY(M)                                                         ISS38100
C         CALC RANGE AT YPL                                                      ISS38200
          Y1 = XX(M)+Y1*(DR(M,2)+(YPL-YY(M+1))*(2.*DR(M,3)+DR(M+1,3)+DR(M,1)ISS38300
```

```
     1*Y1)*.16666667)                                                    ISS38400
      J = J+1                                                            ISS38500
      DR(J,5) = EXP(Y1)                                                  ISS38600
      DR(J,6) = YPL                                                      ISS38700
      IF (J .GE. 244) GO TO 670                                          ISS38800
      GO TO 631                                                          ISS38900
  650 DO 660 M=1,NP                                                      ISS39000
      DR(M,5) = EXP(XX(M))                                               ISS39100
  660 DR(M,6) = YY(M)                                                    ISS39200
      NPI = NP                                                           ISS39300
  670 MP = 1                                                             ISS39400
      IF (IER .EQ. 0) NP = J                                             ISS39500
      DO 675 I=1,NPI                                                     ISS39600
  675 XX(I) = EXP(XX(I))                                                 ISS39700
      IF (KB(L) .NE. 0) GO TO 680                                        ISS39800
      NP = NP+1                                                          ISS39900
      DR(NP,5) = DR(1,5)                                                 ISS40000
      DR(NP,6) = DR(1,6)                                                 ISS40100
  680 CONTINUE                                                           ISS40200
C     CONVERT PLOT POINTS BACK TO SYSTEM RELATIVE TO LAUNCH SITE         ISS40300
      CALL CALCS(DR(1,5),DR(1,6),NP,RAD,RADI,X1,Y1,XSHFT,YSHFT,2,KB(L),  ISS40400
     1YT,X,NX)                                                           ISS40500
C     PLOT CURVE                                                         ISS40600
      IF (ISW3 .EQ. 2) GO TO 694                                         ISS40700
      M = NPI                                                            ISS40800
C     CONVERT PRINT POINTS BACK TO SYSTEM RELATIVE TO LAUNCH SITE        ISS40900
      CALL CALCS(XX,YY,M,RAD,RADI,X1,Y1,XSHFT,YSHFT,1,KB(L),YT,X,NX)     ISS41000
      IF (LINES .GT. 52) GO TO 686                                       ISS41100
      WRITE (6,2000) FI(N),(KLINE(J),J=1,NCV)                            ISS41200
      WRITE (6,2003)                                                     ISS41300
      LINES = LINES+3                                                    ISS41400
      GO TO 687                                                          ISS41500
  686 LINES = 57                                                         ISS41600
  687 CONTINUE                                                           ISS41700
      M1 = -5                                                            ISS41800
  688 M1 = M1+6                                                          ISS41900
      IF (M1 .GT. M) GO TO 692                                           ISS42000
      M2 = M1+5                                                          ISS42100
```


205

```
      IF (M2 .GT. M) M2 = M                                                    ISS42200
      LINES = LINES+1                                                          ISS42300
      IF (LINES .LT. 57) GO TO 691                                             ISS42400
      IF (JM .GT. 1) GO TO 689                                                 ISS42500
      CALL PRTTTL(NWD,LINES,LEGEND,0.0,0.0,ZB,ZT)                              ISS42600
      GO TO 690                                                                ISS42700
  689 CALL PRTTTL(NWD,LINES,LEGEND,DECAY,LAMBDA,ZB,ZT)                         ISS42800
  690 WRITE (6,2000) FI(N),(KLINE(J),J=1,NCV)                                  ISS42900
      WRITE (6,2001)                                                           ISS43000
      LINES = LINES+7                                                          ISS43100
  691 WRITE (6,2002) (XX(J),YY(J),J=M1,M2)                                     ISS43200
      GO TO 688                                                                ISS43300
  692 CONTINUE                                                                 ISS43400
  694 CONTINUE                                                                 ISS43500
      IF (ISW3 .EQ. 1) GO TO 695                                               ISS43600
C     PLOT CURVE                                                               ISS43700
      CALL ILPLOT(DR(MP,5),DR(MP,6),NP,1,DR)                                   ISS43800
  695 CONTINUE                                                                 ISS43900
      IP1 = IP1+NPP(L)                                                         ISS44000
  700 CONTINUE                                                                 ISS44100
  710 CONTINUE                                                                 ISS44200
      IF (ISW3 .EQ. 1) GO TO 800                                               ISS44300
      XPL = -XMIN*SCLX+XLM1-0.5*HT                                             ISS44400
      YPL = -YMIN*SCLY+YBM1-0.5*HT                                             ISS44500
      CALL PRINTV(1,1H*,IFIX(XPL),IFIX(YPL))                                   ISS44700
  800 CONTINUE                                                                 ISS44900
      RETURN                                                                   ISS45000
 2000 FORMAT (1H0,40X,22H*--*-* ISOPLETH LEVEL =,F9.3,2H, ,9A6)                ISS45100
 2001 FORMAT(1H0,6(19H  RANGE     AZIMUTH )/1X,6(19H (METERS)  BEARING )/ISS45200
     11X,6(10X,9H(DEGREES))/1X,19(6H------))                                   ISS45300
 2002 FORMAT (1X,6(F10.3,F8.3,1X))                                             ISS45400
 2003 FORMAT ()                                                                ISS45500
 2004 FORMAT ('0 *** ISOPLETHS OUT OF RANGE FOR ',16A6/(1X,21A6))              ISS45600
      END                                                                      ISS45700
```

```
1*            SUBROUTINE LSSOPT, VERSION  5, REVISION 3
2*
3*            SUBROUTINE LSSOPT(X,Y,NX,NY,FI,VLABEL,LEGEND,NCV,NCHAR)                LSS00100
4*      C     IS ISW = 2 LOG-LOG, IF ISW = 1 LINEAR                                  LSS00200
5*            COMMON /PLTLLO/ ISW,XMAXJN,YMAXJN,XCIZE,YCIZE                          LSS00300
6*            COMMON /BNDS/ XRIT,XLFT,YBOT,YTOP,XPL,YPL                              LSS00400
7*            DIMENSION X(1),Y(1),FI(1)                                              LSS00500
8*            COMMON /ILALPH/LCKIT(10),IBLANK,ISTAR,IP1,IP2,IP3,HLABEL(5),NCH        LSS00600
9*            COMMON /XYXYPT/ YP(41),XP(41),A(41),B(41),C(41),D(41),XI(41),YI(41LSS00700
10*           1),NUM(3),NC                                                           LSS00800
11*           COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY,      LSS00900
12*           1XSIZE1,YSIZE1                                                         LSS01000
13*           DATA DISP,XLN,YBN,XRN,YTN/3.0,62.,102.,24.,22./                        LSS01200
14*           XLM1 = XLN                                                             LSS01300
15*           YBM1 = YBN                                                             LSS01400
16*           XRM1 = XRN                                                             LSS01500
17*           YTM1 = YTN                                                             LSS01600
18*           XSIZE1 = XCIZE                                                         LSS01700
19*           YSIZE1 = YCIZE                                                         LSS01800
20*     C     DETERMINE MAX AND MIN FOR BOTH AXES                                    LSS01900
21*           Y1 = 0.0                                                               LSS02000
22*           J1 = 0                                                                 LSS02100
23*           J2 = 0                                                                 LSS02200
24*           Y2 = 1.0E20                                                            LSS02300
25*           J3 = 0                                                                 LSS02400
26*           DO 50 I=1,NX                                                           LSS02500
27*           IF (Y(I) .LE. 0.0) GO TO 40                                            LSS02600
28*           IF (J1 .GT. 0) GO TO 30                                                LSS02700
29*           J1 = I                                                                 LSS02800
30*           GO TO 31                                                               LSS02900
31*        30 J2 = I                                                                 LSS03000
32*        31 IF (Y(I) .GT. Y1) Y1 = Y(I)                                            LSS03100
33*           IF (Y(I) .LT. Y2) Y2 = Y(I)                                            LSS03200
34*           GO TO 50                                                               LSS03300
35*        40 J3 = 1                                                                 LSS03400
36*        50 CONTINUE                                                               LSS03500
37*           IF (ISW .EQ. 2) GO TO 60                                               LSS03600
38*           IF (J3 .EQ. 1) Y2 = 0.0                                                LSS03700
```


207

```
59*           J1 = 1                                                          LSS03800
40*           J2 = NX                                                         LSS03900
41*           CALL MAXMIN(XMAXJN,X(J1),XMAX,XMIN,X(J2),X(J1),1)               LSS04000
42*           CALL MAXMIN(YMAXJN,Y2,YMAX,YMIN,Y1,Y2,1)                        LSS04100
43*           GO TO 80                                                        LSS04200
44*        60 IF (Y1 .LE. 0.0) GO TO 230                                      LSS04300
45*        61 IF (X(J1) .GT. 0.0) GO TO 70                                    LSS04400
46*           J1 = J1+1                                                       LSS04500
47*           GO TO 61                                                        LSS04600
48*        70 XPL = 10.0**X(J1)                                               LSS04700
49*           YPL = 10.0**X(J2)                                               LSS04800
50*           CALL MAXMIN(XMAXJN,XPL,XMAX,XMIN,YPL,XPL,2)                     LSS04900
51*           CALL MAXMIN(YMAXJN,Y2,YMAX,YMIN,Y1,Y2,2)                        LSS05000
52*        80 CONTINUE                                                        LSS05100
53*     C     DETERMINE PLOT SCALE                                            LSS05200
54*        90 IF (ISW .EQ. 2) GO TO 100                                       LSS05300
55*           SCLX = XSIZE1/(XMAX-XMIN)                                       LSS05400
56*           SCLY = YSIZE1/(YMAX-YMIN)                                       LSS05500
57*           GO TO 110                                                       LSS05600
58*       100 SCLX = XSIZE1/(ALOG10(XMAX)-ALOG10(XMIN))                       LSS05700
59*           SCLY = YSIZE1/(ALOG10(YMAX)-ALOG10(YMIN))                       LSS05800
60*       110 CONTINUE                                                        LSS05900
61*           IF (ISW .EQ. 2) GO TO 115                                       LSS06000
62*           XLFT = XMIN                                                     LSS06100
63*           XRIT = XMAX                                                     LSS06200
64*           YTOP = YMAX                                                     LSS06300
65*           YBOT = YMIN                                                     LSS06400
66*           GO TO 116                                                       LSS06500
67*       115 CONTINUE                                                        LSS06600
68*           XLFT = ALOG10(XMIN)                                             LSS06700
69*           XRIT = ALOG10(XMAX)                                             LSS06800
70*           YTOP = ALOG10(YMAX)                                             LSS06900
71*           YBOT = ALOG10(YMIN)                                             LSS07000
72*       116 CONTINUE                                                        LSS07100
73*           CALL SETMAV(0,0,0,0)                                            LSS07200
74*           CALL FRAMEV(0)                                                  LSS07300
75*           NT = 12                                                         LSS07500
76*           CHARF = 8                                                       LSS07900
```

```
77*      C                                                                      LSS08100
78*      C     DRAW AXES                                                        LSS08200
79*            CALL ILAXES(ISW,VLABEL,HLABEL,NCV,NCH,LEGEND,NCHAR)              LSS08300
80*      C                                                                      LSS08400
81*      C     PLOT CURVE                                                       LSS08500
82*            NC = J2-J1+1                                                     LSS08600
83*            IF (NC .LE. 0) GO TO 220                                         LSS08700
84*            IF (ISW .NE. 2) GO TO 121                                        LSS08800
85*            DO 120 I=J1,J2                                                   LSS08900
86*            Y(I) = ALOG10(Y(I))                                              LSS09000
87*        120 CONTINUE                                                         LSS09100
88*        121 CONTINUE                                                         LSS09200
89*            IF (NC .LT. 3) GO TO 125                                         LSS09300
90*            CALL SPLINE(X(J1),Y(J1),A,B,C,D,NC,IER)                          LSS09400
91*            IF (IER .EQ. 1) GO TO 125                                        LSS09500
92*            DX = (X(J2)-X(J1))/82.0                                          LSS09600
93*            XPL = X(J1)-DX                                                   LSS09700
94*            N = 0                                                            LSS09800
95*            I = 1                                                            LSS09900
96*        123 XPL = XPL+DX                                                     LSS10000
97*            IF (XPL .LT. X(J1+1)) GO TO 124                                  LSS10100
98*            I = I+1                                                          LSS10200
99*        124 IF (I+J1 .GT. J2.OR.N .GE. 82) GO TO 127                         LSS10300
100*           N = N+1                                                          LSS10400
101*           YPL = XPL-X(J1+I-1)                                              LSS10500
102*           YP(N) = Y(J1+I-1)+YPL*(B(I)+(XPL-X(J1+1))*(2.0*C(I)+C(I+1)+A(I)* LSS10600
103*          1YPL)*.1666667)                                                   LSS10700
104*           XA(N) = XPL                                                      LSS10800
105*           GO TO 123                                                        LSS10900
106*       125 DO 126 I=1,NC                                                    LSS11000
107*           XA(I) = X(J1+I-1)                                                LSS11100
108*       126 YP(I) = Y(J1+I-1)                                                LSS11200
109*           N = NC                                                           LSS11300
110*       127 CONTINUE                                                         LSS11400
111*           CALL ILPLOT(XA,YP,N,2,A)                                         LSS11500
112*           IF (NY .EQ. 0.OR.NY .LO. 9) GO TO 220                            LSS11600
113*           XA(N) = 8                                                        LSS11800
114*           IF (ISW .EQ. 2) YMIN = ALOG10(YMIN)                              LSS11900
```

209

```
      DO 210 I=1,NY                                                    LSS12000
      IF (ISA .EQ. 2) GO TO 130                                        LSS12100
      YS = (FI(I)-YMIN)*SCLY+YBM1                                      LSS12200
      GO TO 131                                                        LSS12300
130   YS = (ALOG10(FI(I))-YMIN)*SCLY+YBM1                              LSS12400
131   IF (YS .LT. YBM1) GO TO 210                                      LSS12500
      IF (YS .GT. YBM1+YSIZE1) GO TO 210                               LSS12600
      CALL NMBRS(FI(I),NUM,NC)                                         LSS12700
      X1 = XLM1-XINC                                                   LSS12800
      X2 = XLM1+XSIZE1-FLOAT(NC)*CHARF-DISP                            LSS12900
      IB = 2                                                           LSS13000
      XPL = XLM1                                                       LSS13100
140   X1 = X1+XINC                                                     LSS13200
      IF (X1 .GE. X2) X1 = X2                                          LSS13300
      IF (IB .EQ. 3) GO TO 150                                         LSS13400
      CALL LINE2V(IFIX(XPL),IFIX(YS),IFIX(X1-XPL),0)                   LSS13700
150   IF (X1 .GE. X2) GO TO 170                                        LSS13800
      XPL = X1                                                         LSS13900
      IF (IB .EQ. 2) GO TO 160                                         LSS14000
      IB = 2                                                           LSS14100
      GO TO 140                                                        LSS14200
160   IB = 3                                                           LSS14300
      GO TO 140                                                        LSS14400
170   CALL PRINTV(NC,NUM,IFIX(X2+XINC),IFIX(YS-4.0))                   LSS14600
210   CONTINUE                                                         LSS14700
220   CONTINUE                                                         LSS14800
230   RETURN                                                           LSS14900
      END                                                              LSS15000
```

```
      SUBROUTINE ILAXES, VERSION  5, REVISION 3
C
      SUBROUTINE ILAXES(ISW,VLABEL,HLABEL,NCV,NCH,LEGEND,NCHAR)          ILA00100
      COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY,  ILA00200
     1XSIZE1,YSIZE1                                                     ILA00300
      DIMENSION NUM(3),LEGEND(1),VLABEL(1),HLABEL(1)                    ILA00400
C     ISW = 1 LINEAR AXES                                               ILA00500
C     ISW = 2 LOG-LOG AXES                                              ILA00600
      DATA TIC1/8.0/,TIC2/4.0/,DISP/3.0/                                ILA00800
      DATA XINCMN/14.6/                                                 ILA01000
      IF (ISW .NE. 2) GO TO 40                                          ILA01100
      XST = ALOG10(XMIN)                                                ILA01200
      XINC = 1.0                                                        ILA01300
      K = XST                                                           ILA01400
      XP = K                                                            ILA01500
      IF (XST-XP) 20,60,20                                              ILA01600
   20 IF (XST) 21,21,30                                                 ILA01700
   21 K = K-1                                                           ILA01800
      GO TO 60                                                          ILA01900
   30 K = K+1                                                           ILA02000
      GO TO 60                                                          ILA02100
   40 CONTINUE                                                          ILA02200
C     DETERMINE INCREMENT BETWEEN MINOR TIC MARKS                       ILA02300
      XINC = (XMAX-XMIN)/(XSIZE1*10.0)                                  ILA02400
      IF (XINC*SCLX .LT. XINCMN) XINC = XINCMN/SCLX                     ILA02500
      J = ALOG10(XINC)                                                  ILA02600
      K = XINC*10.0**(-J)                                               ILA02700
      XINC = K*10**J                                                    ILA02800
      XST = 0.0                                                         ILA02900
   50 IF (XST .LE. XMIN) GO TO 60                                       ILA03000
      XST = XST-10.0*XINC                                               ILA03100
      GO TO 50                                                          ILA03200
   60 CONTINUE                                                          ILA03300
      CALL LINE2V(IFIX(XLM1),IFIX(YBM1),0,IFIX(YSIZE1))                 ILA03900
      CALL LINE2V(IFIX(XLM1),IFIX(YBM1+YSIZE1),IFIX(XSIZE1),0)          ILA04000
      CALL LINE2V(IFIX(XLM1+XSIZE1),IFIX(YBM1+YSIZE1),0,-IFIX(YSIZE1))  ILA04100
      CALL LINE2V(IFIX(XLM1+XSIZE1),IFIX(YBM1),-IFIX(XSIZE1),0)         ILA04200
C     PLOT AND LABEL X AXES                                             ILA04300
```

TABLE OF CONTENTS

Section		Title	Page No.	
		INTRODUCTION	1	1/A4
A		USERS' INSTRUCTIONS FOR THE NASA/MSFC CLOUD-RISE PREPROCESSOR PROGRAM—VERSION 6	3	1/A6
	A.1	Program Input Parameters	3	1/A6
	A.2	Program Input Data Card Sequence	4	1/A7
	A.3	Preprocessor Program Output	12	1/B1
	A.4	Fortran Source Listing for the NASA/MSFC Cloud-Rise Preprocessor Program—Version 6	12	1/B1
B		USERS' INSTRUCTIONS FOR THE NASA/MSFC MULTILAYER DIFFUSION COMPUTER PROGRAM—VERSION 6	65	2/B11
	B.1	Program Description	65	2/B11
	B.2	Program Input Parameters	66	2/B12
	B.3	Condensed Table of Namelist Input Parameters	90	2/D8
	B.4	Data Input Format	98	2/E9
	B.5	Fortran Source Listing for the NASA/MSFC Multilayer Diffusion Program—Version 6	99	2/E10

```
      YP = YBM1                                                                    ILA04400
      J = 1                                                                        ILA04500
      DO 150 I=1,2                                                                 ILA04600
      IF (ISW .EQ. 2) GO TO 70                                                     ILA04700
      X = XST-XINC                                                                 ILA04800
      GO TO 80                                                                     ILA04900
   70 L = K -1                                                                     ILA05000
      X = 9.0                                                                      ILA05100
   80 IB = 9                                                                       ILA05200
   90 X = X+XINC                                                                   ILA05300
      IB = IB+1                                                                    ILA05400
      IF (IB .LE. 10) GO TO 95                                                     ILA05500
      IB = 1                                                                       ILA05600
      IF (ISW .NE. 2) GO TO 95                                                     ILA05700
      IB = 2                                                                       ILA05800
      L = L+1                                                                      ILA05900
      X = 2.0                                                                      ILA06000
   95 CONTINUE                                                                     ILA06100
      IF (ISW .EQ. 2) GO TO 100                                                    ILA06200
      XP = (X-XMIN)*SCLX+XLM1                                                      ILA06300
      GO TO 105                                                                    ILA06400
  100 XP = (ALOG10(X*10.0**L)-XST)*SCLX+XLM1                                       ILA06500
  105 IF (XP .LT. XLM1) GO TO 90                                                   ILA06600
      IF (XP .GT. XLM1+XSIZE1) GO TO 140                                           ILA06700
  110 CONTINUE                                                                     ILA06800
      IF (IB .LT. 10) GO TO 130                                                    ILA07100
      CALL LINE2V(IFIX(XP),IFIX(YP),0,IFIX(TIC1)*J)                                ILA07300
      IF (ISW .EQ. 2) GO TO 120                                                    ILA07400
      IB = 0                                                                       ILA07500
      IF (J .LT. 0) GO TO 140                                                      ILA07600
      CALL NMBRS(X,NUM,NCHT)                                                       ILA07700
      CALL PRINTV(NCHT,NUM,IFIX(XP-.5*FLOAT(NCHT)*CHARF),IFIX(YP-HT-DISPILA07900
     1))                                                                           ILA08000
      GO TO 140                                                                    ILA08100
  120 X = L+1                                                                      ILA08200
      IB = 1                                                                       ILA08300
      IF (J .LT. 0) GO TO 125                                                      ILA08400
      CALL PRINTV(2,'10',IFIX(XP-2.0*CHARF),IFIX(YP-HT-3.0*DISP))                  ILA08700
```

```
77*          CALL LABLV(X,IFIX(XP),IFIX(YP-HT-DISP),2,1,2)                    ILA08800
78*      125 CONTINUE                                                         ILA08900
79*          X = 1.0                                                          ILA09000
80*          L = L+1                                                          ILA09100
81*          GO TO 140                                                        ILA09200
82*      130 CALL LINE2V(IFIX(XP),IFIX(YP),0,IFIX(TIC2)*J)                    ILA09400
83*      140 CONTINUE                                                         ILA09500
84*          IF (XP .LT. XLM1+XSIZE1) GO TO 90                                ILA09600
85*          YP = YBM1+YSIZE1                                                 ILA09700
86*          J = -1                                                           ILA09800
87*      150 CONTINUE                                                         ILA09900
88*      C   PLOT AND LABEL Y AXES                                            ILA10000
89*          IF (ISW .NE. 2) GO TO 154                                        ILA10100
90*          XST = ALOG10(YMIN)                                               ILA10200
91*          XINC = 1.0                                                       ILA10300
92*          K = XST                                                          ILA10400
93*          XP = K                                                           ILA10500
94*          IF (XST-XP) 151,156,151                                          ILA10600
95*      151 IF (XST) 152,152,153                                             ILA10700
96*      152 K = K-1                                                          ILA10800
97*          GO TO 156                                                        ILA10900
98*      153 K = K+1                                                          ILA11000
99*          GO TO 156                                                        ILA11100
100*     154 XINC = (YMAX-YMIN)/(YSIZE1*10.0)                                 ILA11200
101*         IF (XINC*SCLY .LT. XINCMN) XINC = XINCMN/SCLY                    ILA11300
102*         J = ALOG10(XINC)                                                 ILA11400
103*         K = XINC*10.0**(-J)                                              ILA11500
104*         XINC = K*10**J                                                   ILA11600
105*         XST = 0.0                                                        ILA11700
106*     155 IF (XST .LE. YMIN) GO TO 156                                     ILA11800
107*         XST = XST-XINC*10.0                                              ILA11900
108*         GO TO 155                                                        ILA12000
109*     156 CONTINUE                                                         ILA12100
110*         XP = XLM1                                                        ILA12200
111*         XD = 5.0                                                         ILA12300
112*         IF (ISW .EQ. 2) XD = 4.0                                         ILA12400
113*         XD = XP-XD*CHARF-DISP                                            ILA12500
114*         J = 1                                                            ILA12600
```

213

```
115*          DO 250 I=1,2                                                    ILA12700
116*          IF (ISW .EQ. 2) GO TO 160                                       ILA12800
117*          X = XST-XINC                                                    ILA12900
118*          GO TO 170                                                       ILA13000
119*      160 L = K-1                                                         ILA13100
120*          X = 9.0                                                         ILA13200
121*      170 IB = 9                                                          ILA13300
122*      180 X = X+XINC                                                      ILA13400
123*          IB = IB+1                                                       ILA13500
124*          IF (IB .LE. 10) GO TO 185                                       ILA13600
125*          IB = 1                                                          ILA13700
126*          IF (ISW .NE. 2) GO TO 185                                       ILA13800
127*          IB = 2                                                          ILA13900
128*          L = L+1                                                         ILA14000
129*          X = 2.0                                                         ILA14100
130*      185 CONTINUE                                                        ILA14200
131*          IF (ISW .EQ. 2) GO TO 190                                       ILA14300
132*          YP = (X-YMIN)*SCLY+YBM1                                         ILA14400
133*          GO TO 200                                                       ILA14500
134*      190 YP = (ALOG10(X*10.0**L)-XST)*SCLY+YBM1                          ILA14600
135*      200 IF (YP .LT. YBM1) GO TO 180                                     ILA14700
136*          IF (YP .GT. YBM1+YSIZE1) GO TO 240                              ILA14800
137*      210 CONTINUE                                                        ILA14900
138*          IF (IB .LT. 10) GO TO 230                                       ILA15200
139*          CALL LINE2V(IFIX(XP),IFIX(YP),IFIX(TIC1)*J,0)                   ILA15400
140*          IF (ISW .EQ. 2) GO TO 220                                       ILA15500
141*          IB = 0                                                          ILA15600
142*          IF (J .LT. 0) GO TO 240                                         ILA15700
143*          CALL NMBRS(X,NUM,NCHT)                                          ILA15800
144*          XF = XP-FLOAT(NCHT)*CHARF-DISP                                  ILA15900
145*          CALL PRINTV(NCHT,NUM,IFIX(XF),IFIX(YP-.5*HT))                   ILA16100
146*          IF (XF .LT. XD) XD = XF                                         ILA16200
147*          GO TO 240                                                       ILA16300
148*      220 X = L+1                                                         ILA16400
149*          IB = 1                                                          ILA16500
150*          IF (J .LT. 0) GO TO 225                                         ILA16600
151*          CALL PRINTV(2,'10',IFIX(XP-4.0*CHARF-DISP),IFIX(YP-.5*HT))      ILA16900
152*          CALL LABLV(X,IFIX(XP-2.0*CHARF-DISP),IFIX(YP+DISP),2,1,2)       ILA17000
```

```
153*      225 CONTINUE                                                          ILA17100
154*          X = 1.0                                                           ILA17200
155*          L = L+1                                                           ILA17300
156*          GO TO 240                                                         ILA17400
157*      230 CALL LINE2V(IFIX(XP),IFIX(YP),IFIX(TIC2)*J,0)                     ILA17600
158*      240 CONTINUE                                                          ILA17700
159*          IF (YP .LT. YBM1+YSIZE1) GO TO 180                                ILA17800
160*          XP = XLM1+XSIZE1                                                  ILA17900
161*          J = -1                                                            ILA18000
162*      250 CONTINUE                                                          ILA18100
163*C         DRAW VERTICAL AXIS LABEL                                          ILA18200
164*          XP = XB-DISP-CHARF                                                ILA18300
165*          YP = (YSIZE1+FLOAT(NCV)*(HT+DISP))*0.5+YBM1                       ILA18500
166*          CALL APRNIV(0,-IFIX(HT+DISP),NCV,VLABEL,IFIX(XP),IFIX(YP))        ILA18700
167*C         DRAW HORIZONTAL AXIS LABEL                                        ILA18800
168*          XP = (XSIZE1-FLOAT(NCH)*CHARF)*0.5+XLM1                           ILA18900
169*          YP = YBM1-2.0*(2.5*DISP+HT)                                       ILA19000
170*          CALL PRINTV(NCH,HLABEL,IFIX(XP),IFIX(YP))                         ILA19200
171*C         DRAW LEGEND FOR PLOT                                              ILA19300
172*          XP = (XSIZE1-90.0*CHARF)*0.5+XLM1                                 ILA19400
173*          YP = YP-HT+DISP                                                   ILA19600
174*          J = -89                                                           ILA19700
175*      260 YP = YP-(HT+DISP)                                                 ILA19800
176*          J = J+90                                                          ILA19900
177*          K = J+89                                                          ILA20000
178*          IF (K .GT. NCHAR) K = NCHAR                                       ILA20100
179*          I = (J/6)+1                                                       ILA20200
180*          CALL PRINTV(K-J+1,LEGEND(I),IFIX(XP),IFIX(YP))                    ILA20400
181*          IF (K .LT. NCHAR) GO TO 260                                       ILA20500
182*          RETURN                                                            ILA20600
183*          END                                                               ILA20700
```

```
      SUBROUTINE ILPLOT, VERSION  5, REVISION 3

      SUBROUTINE ILPLOT(X,Y,N,ISW,IJ)                                          ILP00100
C     THIS SUBROUTINE PLOTS AND LABELS CURVES                                  ILP00200
      COMMON /BNDS/ XRIT,XLFT,YBOT,YTOP,XPL,YPL                                ILP00300
      COMMON /ILPLTS/ XMAX,XMIN,YMAX,YMIN,XLM1,YBM1,HT,CHARF,SCLX,SCLY,        ILP00400
     1XSIZE1,YSIZE1                                                            ILP00500
      DIMENSION X(1),Y(1),IJ(1)                                                ILP00600
      COMMON /XYXYPT/ YP(41),XP(41),A(41),B(41),C(41),D(41),XI(41),YI(41       ILP00700
     1),NUM(3),NC                                                              ILP00800
      IFLG = 0                                                                 ILP00900
      JFLG = 0                                                                 ILP01000
      DO 100 I=1,N                                                             ILP01100
      X1 = X(I)                                                                ILP01200
      Y1 = Y(I)                                                                ILP01300
      IF (XLFT .LE. X1.AND.X1 .LE. XRIT) GO TO 20                              ILP01400
      GO TO 30                                                                 ILP01500
   20 IF (YBOT .LE. Y1.AND.Y1 .LE. YTOP) GO TO 60                              ILP01600
   30 IF (JFLG .EQ. 0) GO TO 50                                                ILP01700
C     LAST POINT WAS OUT, THIS POINT IS OUT                                    ILP01800
   40 IJ(I) = 3                                                                ILP01900
      GO TO 90                                                                 ILP02000
   50 JFLG = 1                                                                 ILP02100
      IF (I .EQ. 1) GO TO 40                                                   ILP02200
C     THIS POINT OUT LAST POINT IN                                             ILP02300
C     INTERP FOR PLOT POINT                                                    ILP02400
      CALL BOUNDS(X1,Y1,XLST,YLST)                                             ILP02500
      ITAG = 1                                                                 ILP02600
      GO TO 80                                                                 ILP02700
   60 IF (JFLG .EQ. 0) GO TO 70                                                ILP02800
C     THIS POINT IN LAST POINT OUT                                             ILP02900
      JFLG = 0                                                                 ILP03000
      CALL BOUNDS(XLST,YLST,X1,Y1)                                             ILP03100
      IJ(I-1) = 0                                                              ILP03200
      X(I-1) = (XPL-XLFT)*SCLX+XLM1                                            ILP03300
      Y(I-1) = (YPL-YBOT)*SCLY+YBM1                                            ILP03400
   70 XPL = X1                                                                 ILP03500
      YPL = Y1                                                                 ILP03600
```

```
*          ITAG = 2                                                    ILP03700
*       60 X(I) = (XPL-XLFT)*SCLX+XLM1                                 ILP03800
*          Y(I) = (YPL-YBOT)*SCLY+YBM1                                 ILP03900
*          IJ(I) = ITAG                                                ILP04000
*       90 XLST = X1                                                   ILP04100
*          YLST = Y1                                                   ILP04200
*      100 CONTINUE                                                    ILP04300
*          IF (ISW .EQ. 2) GO TO 160                                   ILP04400
*      C   IJ = 0 CURVE ENTERS GRAPH - FIRST POINT                     ILP04500
*      C   IJ = 1 CURVE LEAVES GRAPH - LAST POINT                      ILP04600
*      C   IJ = 2 CURVE CONTINUES WITHIN GRAPH                         ILP04700
*      C   IJ = 3 CURVE OUTSIDE OF GRAPH DO NOT PLOT                   ILP04800
*      C                                                               ILP04900
*      C   FIND POINTS FOR ISOPLETH LABELS                             ILP05000
*      C   FIND ALL POINTS WHERE CURVE LEAVES GRAPH                    ILP05100
*          M = 0                                                       ILP05200
*          DO 110 I=1,N                                                ILP05300
*          IF (IJ(I) .NE. 1) GO TO 110                                 ILP05400
*          M = M+1                                                     ILP05500
*          B(M) = X(I)                                                 ILP05600
*          C(M) = Y(I)+.02                                             ILP05700
*      110 CONTINUE                                                    ILP05800
*      C   FIND ALL POINTS WHERE CURVE ENTERS GRAPH                    ILP05900
*          DO 120 I=1,N                                                ILP06000
*          IF (IJ(I) .NE. 0) GO TO 120                                 ILP06100
*          M = M+1                                                     ILP06200
*          B(M) = X(I)                                                 ILP06300
*          C(M) = Y(I)+.02                                             ILP06400
*      120 CONTINUE                                                    ILP06500
*          L = N/2                                                     ILP06600
*          IF (IJ(L) .EQ. 2) GO TO 130                                 ILP06700
*          L = 1                                                       ILP06800
*          IF (IJ(L) .EQ. 2) GO TO 130                                 ILP06900
*          L = N/4                                                     ILP07000
*          IF (IJ(L) .EQ. 2) GO TO 130                                 ILP07100
*          L = 3*N/4                                                   ILP07200
*          IF (IJ(L) .NE. 2) GO TO 140                                 ILP07300
*      130 M = M+1                                                     ILP07400
```


217

```
77*            B(M) = X(L)                                                    ILP07500
78*            C(M) = Y(L)+.02                                                ILP07600
79*          140 CONTINUE                                                     ILP07700
80*      C       PLOT LABELS                                                  ILP07800
81*              XPL = -XLFT*SCLX+XLM1                                        ILP07900
82*              YPL = -YBOT*SCLY+YBM1                                        ILP08000
83*              DO 150 I=1,M                                                 ILP08100
84*              IF (ABS(XPL-B(I)) .GT. 0.2) GO TO 145                        ILP08200
85*              IF (ABS(YPL-C(I)) .LE. 0.2) GO TO 150                        ILP08300
86*          145 CONTINUE                                                     ILP08400
87*              CALL PRINTV(NC,NUM,IFIX(B(I)),IFIX(C(I)))                    ILP08600
88*          150 CONTINUE                                                     ILP08700
89*          160 CONTINUE                                                     ILP08800
90*      C       PLOT THE CURVE                                               ILP08900
91*              IF (IJ(1) .NE. 3) IJ(1) = 0                                  ILP09000
92*              N = N-1                                                      ILP09100
93*              DO 170 I=1,N                                                 ILP09200
94*              IF (IJ(I+1) .EQ. 3) GO TO 170                                ILP09300
95*              IF (IJ(I+1) .EQ. 0) GO TO 170                                ILP09400
96*              CALL LINE2V(IFIX(X(I)),IFIX(Y(I)),IFIX(X(I+1)-X(I)),IFIX(Y(I+1)-Y(ILP09500
97*             1I)))                                                         ILP09600
98*          170 CONTINUE                                                     ILP10000
99*          180 CONTINUE                                                     ILP10100
100*             RETURN                                                       ILP10200
101*             END                                                          ILP10300
```

218

```
1*          SUBROUTINE  CALCS, VERSION  5, REVISION 3
2*
3*          SUBROUTINE CALCS(XX,YY,NP,RAD,RADI,XSHFT,YSHFT,X1,Y1,LLSW,KB,YT,X,CAL00100
4*         1NX)                                                                CAL00200
5*          DIMENSION XX(1),YY(1),XSH(2),X(1)                                  CAL00300
6*          IF (LLSW .NE. 0) GO TO 10                                          CAL00400
7*          IF (KB .NE. 0) GO TO 260                                           CAL00500
8*          DO 200 I=1,NP                                                      CAL00600
9*          IF (XX(I) .LT. 100.0) GO TO 210                                    CAL00700
10*       200 CONTINUE                                                         CAL00800
11*         GO TO 260                                                          CAL00900
12*       210 X2 = 1.0E10                                                      CAL01000
13*         DO 220 I=1,NP                                                      CAL01100
14*         Y2 = ABS(YY(I)-YT)                                                 CAL01200
15*         IF (Y2 .GT. 180.0) Y2 = 360.0-Y2                                   CAL01300
16*         IF (Y2 .GE. X2) GO TO 220                                          CAL01400
17*         X2 = Y2                                                            CAL01500
18*         J = I                                                              CAL01600
19*       220 CONTINUE                                                         CAL01700
20*         X2 = XX(1)                                                         CAL01800
21*         Y2 = YY(1)                                                         CAL01900
22*         XX(1) = XX(J)                                                      CAL02000
23*         YY(1) = YY(J)                                                      CAL02100
24*         XX(J) = X2                                                         CAL02200
25*         YY(J) = Y2                                                         CAL02300
26*         I = 1                                                              CAL02400
27*       230 I = I+1                                                          CAL02500
28*         IF (I .GT. NP) GO TO 260                                           CAL02600
29*         IF (XX(I) .GE. 100.0) GO TO 230                                    CAL02700
30*         I = I+1                                                            CAL02800
31*         IF (I .GT. NP) GO TO 250                                           CAL02900
32*         DO 240 K=I,NP                                                      CAL03000
33*         YY(K-1) = YY(K)                                                    CAL03100
34*       240 XX(K-1) = XX(K)                                                  CAL03200
35*         I = I-2                                                            CAL03300
36*       250 NP = NP-1                                                        CAL03400
37*         GO TO 230                                                          CAL03500
38*       260 CONTINUE                                                         CAL03600
```

```
C      DETERMINE CENTER OF FUNCTION                                          CAL03700
       XSHFT = -1.0E10                                                       CAL03800
       YSHFT = -1.0E10                                                       CAL03900
       X2 = 1.0E10                                                           CAL04000
       Y2 = 1.0E10                                                           CAL04100
       DO 4 I=1,NP                                                           CAL04200
       XSHFT = AMAX1(XSHFT,XX(I))                                            CAL04300
       YSHFT = AMAX1(YSHFT,YY(I))                                            CAL04400
       X2 = AMIN1(X2,XX(I))                                                  CAL04500
       Y2 = AMIN1(Y2,YY(I))                                                  CAL04600
     4 CONTINUE                                                              CAL04700
       XSHFT = 0.5*(XSHFT+X2)                                                CAL04800
       YSHFT = 0.5*(YSHFT+Y2)                                                CAL04900
       IF (KB .NE. 0) GO TO 9                                                CAL05000
       XSHFT = 0.2*XSHFT+0.8*X2                                              CAL05100
       DIF2 = -1.0                                                           CAL05200
       DIF3 = 0.0                                                            CAL05300
       DO 350 L=1,NX                                                         CAL05400
       DO 300 K=1,NP                                                         CAL05500
       IF (XX(K)-X(L)) 300,310,300                                           CAL05600
   300 CONTINUE                                                              CAL05700
       GO TO 350                                                             CAL05800
   310 Y2 = YY(K)                                                            CAL05900
       K = K+1                                                               CAL06000
       IF (K .GE. NP) GO TO 350                                              CAL06100
       DO 320 J=K,NP                                                         CAL06200
       IF (XX(J)-X(L)) 320,330,320                                           CAL06300
   320 CONTINUE                                                              CAL06400
       GO TO 350                                                             CAL06500
   330 DIF1 = DIF2                                                           CAL06600
       DIF2 = DIF3                                                           CAL06700
       DIF3 = ABS(YY(J)-Y2)                                                  CAL06800
       IF (DIF3 .GT. 180.0) DIF3 = 360.0-DIF3                                CAL06900
       IF (DIF1 .LE. DIF2.OR.DIF2 .GE. DIF3) GO TO 340                       CAL07000
       YSHFT = X2                                                            CAL07100
       GO TO 360                                                             CAL07200
   340 CONTINUE                                                              CAL07300
       X2 = 0.5*(YY(J)+Y2)                                                   CAL07400
```

```
 77*       350 CONTINUE                                                    CAL07500
 78*           GO TO 9                                                     CAL07600
 79*       360 CONTINUE                                                    CAL07700
 80*           DO 5 J=2,NP                                                 CAL07800
 81*           DO 5 I=2,NP                                                 CAL07900
 82*           IF (XX(I) .GE. XX(I-1)) GO TO 5                             CAL08000
 83*           X2 = XX(I)                                                  CAL08100
 84*           Y2 = YY(I)                                                  CAL08200
 85*           XX(I) = XX(I-1)                                             CAL08300
 86*           YY(I) = YY(I-1)                                             CAL08400
 87*           XX(I-1) = X2                                                CAL08500
 88*           YY(I-1) = Y2                                                CAL08600
 89*         5 CONTINUE                                                    CAL08700
 90*           DO 8 J=1,2                                                  CAL08800
 91*           XSH(J) = 0.0                                                CAL08900
 92*           DIF2 = -2.0                                                 CAL09000
 93*           DIF3 = -1.0                                                 CAL09100
 94*           DO 7 I=1,NP                                                 CAL09200
 95*           IF (J .EQ. 1.AND.YY(I) .LE. YSHFT) GO TO 7                  CAL09300
 96*           IF (J .EQ. 2.AND.YY(I) .GE. YSHFT) GO TO 7                  CAL09400
 97*           DIF1 = DIF2                                                 CAL09500
 98*           DIF2 = DIF3                                                 CAL09600
 99*           DIF3 = ABS(YY(I)-YSHFT)                                     CAL09700
100*           DIF3 = RAD*DIF3*XX(I)                                       CAL09800
101*           IF (DIF1 .LE. DIF2.OR.DIF2 .GE. DIF3) GO TO 7               CAL09900
102*           XSH(J) = XX(I-1)                                            CAL10000
103*           GO TO 8                                                     CAL10100
104*         7 CONTINUE                                                    CAL10200
105*         8 CONTINUE                                                    CAL10300
106*           IF (XSH(1) .LE. 0.0.OR.XSH(2) .LE. 0.0) GO TO 9             CAL10400
107*           XSH(1) = AMAX1(XSH(1),XSH(2))                               CAL10500
108*           XSHFT = XSH(1)                                              CAL10600
109*         9 CONTINUE                                                    CAL10700
110*           Y2 = YSHFT*RAD                                              CAL10800
111*           YSHFT = XSHFT*COS(Y2)                                       CAL10900
112*           XSHFT = XSHFT*SIN(Y2)                                       CAL11000
113*        10 CONTINUE                                                    CAL11100
114*     C     CONVERT TO RECTANGULAR                                      CAL11200
```


221

```
      DO 11 I=1,NP                                                    CAL11300
      Y2 = YY(I)*RAD                                                  CAL11400
      YY(I) = XX(I)*COS(Y2)+Y1                                        CAL11500
      XX(I) = XX(I)*SIN(Y2)+X1                                        CAL11600
   11 CONTINUE                                                        CAL11700
      IF (LLSW .EQ. 2) GO TO 101                                      CAL11800
      DO 20 I=1,NP                                                    CAL11900
      IF (LLSW .EQ. 1) GO TO 17                                       CAL12000
C     CONVERT POINTS TO SYSTEM RELATIVE TO CENTER OF ELLIPSE          CAL12100
      XX(I) = XX(I)-XSHFT                                             CAL12200
      YY(I) = YY(I)-YSHFT                                             CAL12300
   17 CONTINUE                                                        CAL12400
C     BACK TO POLAR                                                   CAL12500
      IF (XX(I)) 19,18,19                                             CAL12600
   18 IF (YY(I)) 19,20,19                                             CAL12700
   19 YPL = 90.0-ATAN2(YY(I),XX(I))*RADI                              CAL12800
      IF (YPL .LT. 0.0) YPL = YPL+360.0                               CAL12900
      XX(I) = SQRT(XX(I)*XX(I)+YY(I)*YY(I))                           CAL13000
      YY(I) = YPL                                                     CAL13100
      IF (LLSW .EQ. 1) YY(I) = AMOD(YPL,360.0)                        CAL13200
   20 CONTINUE                                                        CAL13300
      IF (LLSW .EQ. 1) GO TO 101                                      CAL13400
C     SORT POINTS INTO ASCENDING ORDER OF ANGLE                       CAL13500
      DO 30 M=2,NP                                                    CAL13600
      DO 30 I=2,NP                                                    CAL13700
      IF (YY(I) .GE. YY(I-1)) GO TO 30                                CAL13800
      YPL = YY(I)                                                     CAL13900
      YY(I) = YY(I-1)                                                 CAL14000
      YY(I-1) = YPL                                                   CAL14100
      YPL = XX(I)                                                     CAL14200
      XX(I) = XX(I-1)                                                 CAL14300
      XX(I-1) = YPL                                                   CAL14400
   30 CONTINUE                                                        CAL14500
C     ELIMINATE UNWANTED POINTS                                       CAL14600
      I = 1                                                           CAL14700
   32 I = I +1                                                        CAL14800
      IF (I .GT. NP) GO TO 35                                         CAL14900
      IF (YY(I)-YY(I-1) .GE. 1.0) GO TO 32                            CAL15000
```

```
153*            I = I +1                                                        CAL15100
154*            IF ( I .GT. NP) GO TO 34                                        CAL15200
155*            DO 33 J=I,NP                                                    CAL15300
156*            YY(J-1) = YY(J)                                                 CAL15400
157*         33 XX(J-1) = XX(J)                                                 CAL15500
158*            I = I-2                                                         CAL15600
159*         34 NP = NP-1                                                       CAL15700
160*            GO TO 32                                                        CAL15800
161*         35 CONTINUE                                                        CAL15900
162*            IF (KB .NE. 0) GO TO 101                                        CAL16000
163*      C     ELIMINATE ANY POINTS THAT ARE HIDDEN FROM DIRECT SIGHT FROM CENTERCAL16100
164*            J = 0                                                           CAL16200
165*         40 J = J+1                                                         CAL16300
166*            IF (J .GE. NP-1) GO TO 50                                       CAL16400
167*            J1 = J + 1                                                      CAL16500
168*            J2 = J1+9                                                       CAL16600
169*            IF (J2 .GT. NP) J2 = NP                                         CAL16700
223 170*       41 IF (ABS(YY(J)-YY(J2)) .LE. 10.0) GO TO 42                       CAL16800
171*            J2 = J2-1                                                       CAL16900
172*            GO TO 41                                                        CAL17000
173*         42 IF (J2 .LT. J1) GO TO 40                                        CAL17100
174*            Y2 = YY(J)*RAD                                                  CAL17200
175*            X2 = XX(J)*SIN(Y2)                                              CAL17300
176*            Y2 = XX(J)*COS(Y2)                                              CAL17400
177*            XT = 1.0E20                                                     CAL17500
178*            M = J1                                                          CAL17600
179*            DO 45 I=J1,J2                                                   CAL17700
180*            TH2 = YY(I)*RAD                                                 CAL17800
181*            TH1 = XX(I)*SIN(TH2)                                            CAL17900
182*            TH2 = XX(I)*COS(TH2)                                            CAL18000
183*            XP = (X2-TH1)**2+(Y2-TH2)**2                                    CAL18100
184*            IF (XP .GE. XT) GO TO 45                                        CAL18200
185*            XT = XP                                                         CAL18300
186*            M = I                                                           CAL18400
187*         45 CONTINUE                                                        CAL18500
188*            IF (M .EQ. J1) GO TO 40                                         CAL18600
189*            TH1 = XX(J1)                                                    CAL18700
190*            TH2 = YY(J1)                                                    CAL18800
```

```
     XA(J1) = XX(M)                                                    CAL18900
     YY(J1) = YY(M)                                                    CAL19000
     XX(M) = TH1                                                       CAL19100
     YY(M) = TH2                                                       CAL19200
     GO TO 40                                                          CAL19300
  50 CONTINUE                                                          CAL19400
     J = 1                                                             CAL19500
  55 J = J+1                                                           CAL19600
     IF (J .GT. NP) GO TO 70                                           CAL19700
     IF (YY(J) .GT. YY(J-1)) GO TO 55                                  CAL19800
     J1 = J+1                                                          CAL19900
     IF (J1 .GT. NP) GO TO 65                                          CAL20000
     DO 60 I=J1,NP                                                     CAL20100
     XX(I-1) = XX(I)                                                   CAL20200
  60 YY(I-1) = YY(I)                                                   CAL20300
     J = J-1                                                           CAL20400
  65 NP = NP-1                                                         CAL20500
     GO TO 55                                                          CAL20600
  70 CONTINUE                                                          CAL20700
 101 RETURN                                                            CAL20800
     END                                                               CAL20900
```

```
1*          SUBROUTINE FSTPLT, VERSION  5, REVISION 3
2*
3*          SUBROUTINE FSTPLT(A,B,C,I,J,K,D,E,F,V1,V2,V3,N1,N2,N3,XP)          FST00100
4*          DIMENSION I(1),J(1),K(1),LSTK(2),V1(1),V2(1),V3(1)                FST00200
5*          DATA MTRS/6HMETERS/                                               FST00300
6*          IF (K(1) .EQ. LSTK(1).AND.K(2) .EQ. LSTK(2)) GO TO 40             FST00400
7*          CALL SETMIV(0,0,0,0)                                              FST00500
8*          CALL FRAMEV(0)                                                    FST00600
9*          CALL PRINTV(72,1,200,800)                                         FST00700
10*         CALL PRINTV(37,37HADJUSTED CLOUD STABILIZATION HEIGHT =,200,750)  FST00800
11*         CALL LABLV(A,504,750,7,1,4)                                       FST00900
12*         CALL PRINTV(6,MTRS,568,750)                                       FST01000
13*         CALL PRINTV(7,7HRANGE =,200,725)                                  FST01100
14*         CALL LABLV(B,272,725,7,1,5)                                       FST01200
15*         CALL PRINTV(6,MTRS,336,725)                                       FST01300
16*         CALL PRINTV(17,17HAZIMUTH BEARING =,200,700)                      FST01400
17*         CALL LABLV(C,352,700,6,1,3)                                       FST01500
18*         CALL PRINTV(7,7HDEGREES,416,700)                                  FST01600
19*         CALL PRINTV(8,8HRUN DATE,200,650)                                 FST01700
20*         CALL PRINTV(8,J,288,650)                                          FST01800
21*         CALL PRINTV(8,8HRUN TIME,400,650)                                 FST01900
22*         CALL PRINTV(8,K,488,650)                                          FST02000
23*         IDY = 625                                                         FST03800
24*         IF (N1 .LT. 0) GO TO 10                                           FST03900
25*         IDY = IDY-25                                                      FST04100
26*         CALL PRINTV(7,7HMAXIMUM,200,IDY)                                  FST04200
27*         CALL PRINTV(N1,V1,264,IDY)                                        FST04300
28*         CALL LABLV(D,264+8*(N1+1),IDY,-6,1,0)                             FST04400
29*      10 IF (N2 .LT. 0) GO TO 20                                           FST04800
30*         IDY = IDY-25                                                      FST05000
31*         CALL PRINTV(7,7HMAXIMUM,200,IDY)                                  FST05100
32*         CALL PRINTV(N2,V2,264,IDY)                                        FST05200
33*         CALL LABLV(E,264+8*(N2+1),IDY,-6,1,0)                             FST05300
34*      20 IF (N3 .LT. 0) GO TO 30                                           FST05700
35*         IDY = IDY-25                                                      FST05900
36*         CALL PRINTV(7,7HMAXIMUM,200,IDY)                                  FST06000
37*         CALL LABLV(XP,264,IDY,4,1,2)                                      FST06100
38*         CALL PRINTV(6,6HMINUTE,304,IDY)                                   FST06200
```

```
      CALL PRINTV(N3,V3,352,IDY)                                    FST06300
      CALL LABLV(F,352+8*(N3+1),IDY,-6,1,0)                         FST06400
   30 CONTINUE                                                      FST07000
      LSTK(1) = K(1)                                                FST07200
      LSTK(2) = K(2)                                                FST07300
   40 RETURN                                                        FST07400
      END                                                           FST07500
```

```
1*            SUBROUTINE MAXMIN, VERSION  5, REVISION 1
2*
3*            SUBROUTINE MAXMIN(A,B,C,D,E,F,ISW)                                MAX00100
4*      C     THIS SUBROUTINE DETERMINES MAX & MIN FOR PLOTTING FUNCTION VS.    MAX00200
5*      C     DISTANCE A,B ARE INPUT MAX AND MIN, C AND D ARE CALC MAX AND MIN  MAX00300
6*      C     DETERMINE MAX AND MIN                                             MAX00400
7*            IF (ISW .EQ. 2) GO TO 10                                          MAX00500
8*            IF (A .GT. 0.0) GO TO 80                                          MAX00600
9*      C     LINEAR SCALING                                                    MAX00700
10*           C = E                                                             MAX00800
11*           D = F                                                             MAX00900
12*           GO TO 90                                                          MAX01000
13*        10 CONTINUE                                                          MAX01100
14*           XX = 4.0                                                          MAX01200
15*           IF (A .GT. 0.0) XX = A                                            MAX01300
16*     C     LOG-LOG SCALING                                                   MAX01400
17*           C = ALOG10(E)                                                     MAX01500
18*           K = C                                                             MAX01600
19*           X = K                                                             MAX01700
20*           IF (X-C) 20,30,20                                                 MAX01800
21*        20 K = K+1                                                           MAX01900
22*        30 C = 10.0**K                                                       MAX02000
23*           D = 1.0                                                           MAX02100
24*           IF (F .LE. 0.0) GO TO 40                                          MAX02200
25*           D = F                                                             MAX02300
26*        40 D = ALOG10(D)                                                     MAX02400
27*           J = D                                                             MAX02500
28*           X = J                                                             MAX02600
29*           IF (X-D) 50,60,50                                                 MAX02700
30*        50 IF (D .LT. 0.0) J = J-1                                           MAX02800
31*        60 IF (FLOAT(K-J) .LE. XX) GO TO 70                                  MAX02900
32*           J = J+1                                                           MAX03000
33*           GO TO 60                                                          MAX03100
34*        70 D = 10.0**J                                                       MAX03200
35*           GO TO 90                                                          MAX03300
36*        80 C = A                                                             MAX03400
37*           D = B                                                             MAX03500
38*        90 RETURN                                                            MAX03600
```

```
39*          END
```

MAX03700

228

```
1*            SUBROUTINE BOUNDS, VERSION  5, REVISION 1
2*
3*            SUBROUTINE BOUNDS(X1,Y1,XLST,YLST)                          BND00100
4*      C     CONFINE PLOT POINTS INSIDE OF AXES                          BND00200
5*            COMMON /BNDS/ XRIT,XLFT,YBOT,YTOP,XPL,YPL                   BND00300
6*            A = (YLST-Y1)/(XLST-X1)                                     BND00400
7*            B = Y1-A*X1                                                 BND00500
8*            IF (X1 .GT. XRIT) GO TO 90                                  BND00600
9*            IF (X1 .LT. XLFT) GO TO 60                                  BND00700
10*           IF (Y1 .LT. YBOT) GO TO 20                                  BND00800
11*           YPL = YTOP                                                  BND00900
12*       10  XPL = (YPL-B)/A                                             BND01000
13*           GO TO 110                                                   BND01100
14*       20  IF (X1 .GT. XRIT) GO TO 50                                  BND01200
15*           IF (X1 .LT. XLFT) GO TO 30                                  BND01300
16*           YPL = YBOT                                                  BND01400
17*           GO TO 10                                                    BND01500
18*     C     LOWER LEFT HAND CORNER ASSUME CROSSES XLFT                  BND01600
19*       30  XPL = XLFT                                                  BND01700
20*       40  YPL = A*XPL+B                                              BND01800
21*           IF (YPL .GE. YBOT) GO TO 110                                BND01900
22*     C     WRONG CROSSES YBOT                                          BND02000
23*           YPL = YBOT                                                  BND02100
24*           GO TO 10                                                    BND02200
25*     C     LOWER RIGHT HAND CORNER ASSUME CROSSES XRIT                 BND02300
26*       50  XPL = XRIT                                                  BND02400
27*           GO TO 40                                                    BND02500
28*       60  IF (Y1 .GT. YTOP) GO TO 70                                  BND02600
29*           IF (Y1 .LT. YBOT) GO TO 30                                  BND02700
30*           XPL = XLFT                                                  BND02800
31*           GO TO 40                                                    BND02900
32*     C     UPPER LEFT HAND CORNER ASSUME CROSSES XLFT                  BND03000
33*       70  XPL = XLFT                                                  BND03100
34*       80  YPL = A*XPL+B                                              BND03200
35*           IF (YPL .LE. YTOP) GO TO 110                                BND03300
36*     C     WRONG CROSSES YTOP                                          BND03400
37*           YPL = YTOP                                                  BND03500
38*           GO TO 10                                                    BND03600
```


229

```
39*          50 IF (Y1 .LT. YBOT) GO TO 50                                  BND03700
40*             IF (Y1 .GT. YTOP) GO TO 100                                 BND03800
41*             XPL = XRIT                                                  BND03900
42*             GO TO 40                                                    BND04000
43*       C     UPPER RIGHT HAND CORNER ASSUME CROSSES XRIT                 BND04100
44*         100 XPL = XRIT                                                  BND04200
45*             GO TO 80                                                    BND04300
46*         110 RETURN                                                      BND04400
47*             END                                                         BND04500
```

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
NASA CR-2945		

4. TITLE AND SUBTITLE	5. REPORT DATE
Users' Instructions for the NASA/MSFC Cloud-Rise Preprocessor Program — Version 6, and the NASA/MSFC Multilayer Diffusion Program — Version 6 (Research Version for Univac 1108 System)	January 1978
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT #
J. R. Bjorklund and R. K. Dumbauld	M-245
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. WORK UNIT NO.
H. E. Cramer Company, Inc. University of Utah Research Park P.O. Box 8049 Salt Lake City, Utah 84108	11. CONTRACT OR GRANT NO. NAS8-31841
	13. TYPE OF REPORT & PERIOD COVERED
12. SPONSORING AGENCY NAME AND ADDRESS	Contractor
National Aeronautics and Space Administration Washington, D. C. 20546	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared under the technical monitorship of Dr. J. B. Stephens, Environmental Effects Task Team Leader, Atmospheric Sciences Division, Space Sciences Laboratory, NASA/Marshall Space Flight Center

16. ABSTRACT

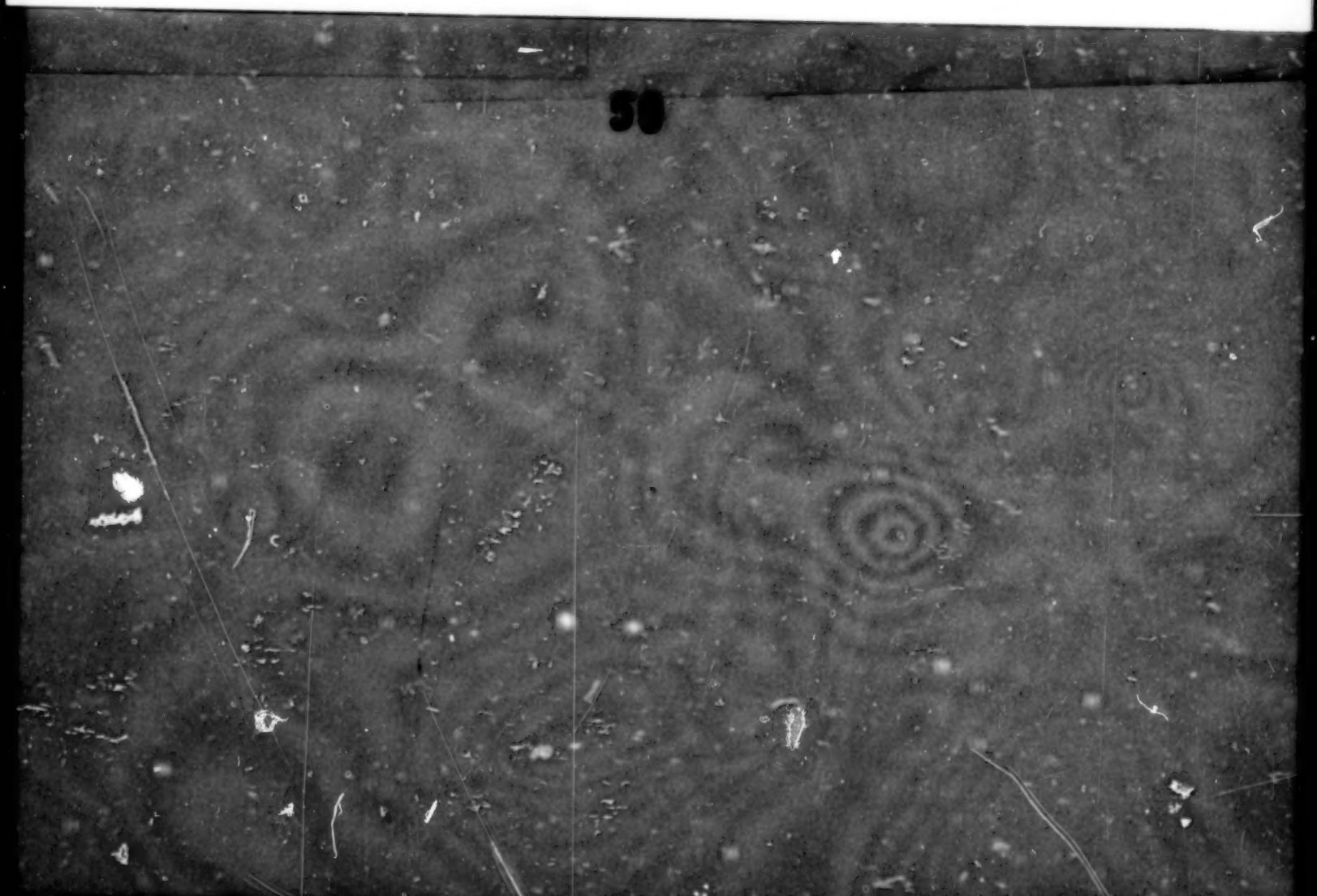
This report provides users' instructions for Version 6 of the NASA/MSFC Cloud-Rise Preprocessor and Multilayer Diffusion Computer Programs. These programs are for use by NASA in predicting concentrations and dosages downwind from normal and abnormal launches of rocket vehicles. Version 6 of these programs differs from Version 5, described in NASA CR-2631, and now incorporates: (1) the latest data for the heat content and chemistry of rocket exhaust clouds, (2) provision for the automated calculation of surface water pH due to deposition of HCl from precipitation scavenging, (3) provision for automated calculation of concentration and dosage parameters at any level within the vertical bounds for which meteorological inputs have been specified, and (4) provision for execution of multiple cases of meteorological data. In addition, some calculation procedures, such as the procedures used to automatically calculate wind direction shear in a layer, have been updated.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Atmospheric Diffusion Multilayer Diffusion Model Rocket Motor Exhaust Diffusion Space Shuttle Environmental Studies	Category 45

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	232	$9.50

* For sale by the National Technical Information Service, Springfield, Virginia 22161

NASA-Langley, 1978


50

END

NOV 2 8 1978